AMERICAN RAILROAD JOURNAL

NEW YORK [ETC.]

V. 16, 1843

W G Pearson

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

VOL. I.—THIRD SERIES,
OR
VOL. XVI.

NEW YORK:
PUBLISHED BY THE EDITORS AND PROPRIETORS,
GEORGE C. SCHAEFFER AND D. K. MINOR.
23 *Chambers street, cor. Centre.*

1843.

PIERCY & REED, PRINTERS,
9 Spruce-St., N. Y.

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AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 1, Vol. X. New Series.] JANUARY, 1843. [Whole No. 421 Vol. XVI.

To Subscribers.

Having advocated the principle of low fares, we are determined not to suffer our practice to fall behind our doctrine. Although our circulation from the nature of the work, is limited to those engaged, or, in any wise interested in Internal Improvement, we hope to increase the number of these, and enlist all classes in its favor. The American Railroad Journal, was commenced when but *one hundred miles* of Railway were in use in the United States. Now there are nearly *five thousand*—and having continued thus far under many difficulties, we consider that an ample guarantee has been given for its future continuance. Being desirous of strictly adopting the *cash system*, and of accomodating ourselves, to the spirit of the times we propose making the following changes.

The American Railroad Journal will hereafter be published once a month, and on the first day of each month. Each monthly number will contain 32 pages. The original matter will be printed in the same type as heretofore but not *leaded* so that each page will contain one third more than before. All selected matter will be printed in smaller type—but in general it will be our endeavor to give a condensation of foreign and domestic intelligence rather than mere selections. Each volume will therefore contain as much, if not more matter than formerly, and the result of more editorial labor.

By this arrangement the postage to distant subscribers will also be greatly reduced.

The terms will hereafter be

Three dollars a year if paid on receipt of the first number.

Five dollars for two years, if paid likewise in advance.

And Five dollars a year to those who do not pay in advance.

Subscribers who have paid five dollars in advance from July 1842 will therefore receive the Journal, until January 1844, instead of July 1843.

Subscribers who do not pay on receipt of this number, being already six months in arrears, will be charged Five dollars to July 1843.

To those of our subscribers, who, by prompt payment, or any other assistance have given us their support we return our warmest thanks, with the assurance that no effort will be spared to repay their confidence.

From various causes, and also in order to issue an extra impression of this number some delay has arisen. Arrangements are making, by which the numbers hereafter, can be sent to city subscribers, and mailed to others, on, or before the first day of each month.

The Progress of Railroads since the Commencement of the American Railroad Journal.

The History of Railroads in the United States presents one of the most remarkable instances of the rapid progress of invention which has ever been recorded. A few years since the advocates of Railroads were ranked among visionaries and schemers, but so rapid has been the growth of the system among us that the small begining and its recent date are very generally forgotten. The history of this Journal will afford evidence upon this point which may suggest useful reflections. Eleven years ago the first number of the American Railroad Journal was isued by Mr. D. K. Minor. This number contains a list of works already in construction and partly finished. As nearly as can be ascertained the following list contains the whole amount of Railroads then in use.

Baltimore and Ohio	60	miles	completed and	in use.
Albany and Schenectady	12	"	"	"
Charlestown and Hamburg about	20	"	"	"
Mauch Chunk	9	"	"	"
Quincy near Boston	6	"	"	"

Thus there were but 92 miles in use upon any of the main lines of Railroads.

So little indeed was there known, and so little could there be said on the subject that the Editor announced, that a part only of the

Journal would be devoted to the subject of internal communication —that the larger part would be occupied with literary and miscellaneous matter as prepared for the New York American. But small as the quantity of matter was, several vigorous articles might even now be read with profit, and among these we might mention those relative to the comparative merits of Railroads and Canals. Although for nearly one hundred and fifty years *tram' roads* had been used for the transportation of the heaviest articles such as coal, ore and stone—it was suddenly discovered that Railroads might indeed be profitably employed in transporting passengers and *light parcels*, but that beyond this they were not able to do any thing. The arguments which were then used and which have since been urged with so much force from time to time have not been without effect.

An idea of the small amount of business connected with Railroads, at the time of the commencement of the Journal, may be formed from the fact that throughout the first volume, but three advertisements, (excepting notices to contractors,) are to be found. The first of these was by Mr H. Burden of Troy, another by Messrs. A. & G. Ralston of Philadelphia and another by Townsend and Durfee, Palmyra N. Y.—the first two of which in some shape or other have been continued, and are yet to be found upon our cover.

The Editor also thought necessary to refer to several gentlemen of this city as guarantees for the continuance of the work. Before many numbers had been issued, information from all quarters poured in and a very lively interest was felt in the undertaking. The demand for Railroads throughout the country increased and popular as well as scientific information was in request.

Let us now compare the present state of affairs with this humble commencement. There are now between *four and five thousand* miles of Railroad in use in the United States built by the expenditure of nearly one hundred millions of dollars. Eleven years ago there were but about one hundred miles in use.

There are now probably more than *five hundred* locomotive engines in use nearly all of them made in this country. Eleven years ago the few engines in use were imported from England and were of the oldest patterns. Since then fifty or more American engines have been sent abroad, some to Russia—some to Austria and several to England. Had this fact been predicted even in the most indirect manner in the first number of the Railroad Journal, it would have sealed its doom.

Eleven years ago a dead level was by many deemed necessary

on a Railroad (see p. 68, vol. 1,) and grades of 30 feet to the mile were hardly thought admissible. Now, Engines are in daily use which surmount grades of 60 and 80 feet to the mile.

Eleven years ago inclined planes with stationary power were considered the neplus ultra of engineering science—now they are discarded as expensive, inconvenient and incompatible with the free use of a Railroad.

Eleven years ago it was thought that Railroads could not compete with canals in carrying heavy freight, and even much more recently, statements to this effect have been put forth by authority. Now we know that the most profitable of the Eastern Railroads derives one half its income from bulky freight—and that coal can be carried more cheaply upon a Railroad than in canals.

Eleven years ago the profitableness of Railroads was not established and discouraged by the vast expenditure in several cases of experiment in an untried field, many predicted that they would be unprofitable. Now it is already demonstrated by declared dividends, that well constructed Railroads when divested of extraneous incumbrances are the most profitable investments in our country. The New England Railroads have paid since their completion 6 to 8 per cent.—Several other roads 6 and 7 per cent. The Hudson and Mohawk of 15½ miles costing about one million, one hundred thousand, paid in 1840 *seven* per cent. on that enormous outlay. The Utica and Schenectady, and Syracuse and Utica, pay 10 to 12 per cent. The Stock of the Utica and Schenectady Railroad has never been down to par since operations were commenced in 1836 and has maintained its stand without fluctuation at a higher rate than any other species of stock during all our commercial revolutions.

Eleven years ago there were but six miles of Railroad in use in the vicinity of Boston. Now Boston has direct connection with a web of Railways *one thousand two hundred and three miles in length*, all of which except about 24 miles are actually in use, being a greater length of Railroad than there was in the whole world, eleven years ago.

We have but one instance to record of a want of correspondence with the general advance of the system. In the first number of the Railroad Journal at the head of the list of applications to the Legislature for charters, we find the New York and Erie, and New York and Albany Railroads. Throughout the first volume, and in each succeding volume are to be found various articles in behalf of these two works. Neither of them is yet completed. One has

a portion complete, and in successful operation, the other has barely commenced construction. That these great works have not yet been finished is no fault of their friends, who have with untiring industry, advocated their claims and that of Railroads generally—and indeed we may safely say that the Railroad system has derived its impetus, in our section of the country at least—from the efforts of those who have labored in behalf of these works. Many untoward circumstances have delayed their construction—but the chief obstacle has been the singular indifference of capitalists in the city of New York—who in one way or other have sunk in this period, more money than would have constructed two works which would have rendered our city a commercial focus, unrivalled in the world.

A better feeling now exists, and we hope, ere long, to see the fulfilment of our best wishes—indeed it is no longer a matter of choice but of necessity. In the city of New York taxes have increased to such an amount that unless every effort is made to concentrate the business of the country, trade will flow through other channels, and find a more ready outlet, where enterprise and capital may direct.

We would do great injustice to the spirit of enterprise in our country, were we to omit mention of another great work which has been completed in this period—the Croton Acqueduct—one of the finest achievements of Engineering science in modern times. This magnificent work, by an acqueduct of 32 miles in length is designed to furnish an abundant supply of the purest water ever tasted by man, to the City of New York. The whole character of the work in that of solidity and utility—with no attempts at display, it impresses the mind solely by its magnitude and great value. The Acqueduct Bridge, at Harlem River when completed will not suffer from a comparison with any similar structure in the world.

When we seriously contemplate the great things which have thus been accomplished in the brief space of eleven years, can we wonder that the friends of Railroads, place unbounded reliance in that energy and spirit of enterprise which have already performed so much, trusting that in such a vast and active nation as our own the germ of prosperity will never perish, even if retarded in its growth by untoward circumstances or injured by national calamity. Nor can it create surprise that those who have endeavored to record the rapid advance of this great national enterprise, should feel enthusiastic in a cause for which they have so long labored and an honest pride in having even in the smallest degree and in the humblest manner contributed to its interest.

IMPORTANT FACTS RELATING TO RAILROADS.

With a view to the diffusion of popular information upon the subject of Railroads we have collected in this number several tables and statements which being short and readily intelligible at a glance may be considered as forming a condensation of Railway statistics. This information is drawn from various authentic sources.—We are indebted for some, to the " Sketch of a Railway" which has been several times noticed in this Journal—but all are derived from official statements, mostly recorded in this work.

PROFIT OF RAILROADS.

The Chev. de Gerstner in the years 1839–40, himself or by his assistant visited every Railroad in the United States, and enjoyed remarkable opportunities for obtaining information. We stated as the result of his observation—that notwithstanding the very short time since these works had commenced operations—and notwithstanding the difficulties of some roads arising from an insufficient capital or a deficient traffic—the average of all the Railroads then in operation in the United States was *a dividend of five and a half per cent., on the capital invested.* He also states that "on all the lines there is a yearly increase of at least 15 to 20 per cent. in the gross income, so that even those which do not pay now will give in a few years a handsome dividend." He also affirms that from the information collected there can be no doubt that the large capital invested in Railroads, will not only produce an incalculable benefit to the country, but also pay the shareholders a dividend which under good management, by the constant progressing population and trade, must likewise from year to year increase."

PROFITS OF VARIOUS RAILROADS.

ROAD.	Length Miles	Highest Grade p Mile	COST.	Annual Dividends—per cent. 1837.	1838.	1839.	1840.	1841.
Boston and Lowell	$25\frac{3}{4}$	10	$1,834,893	7	7	8	8	8
Boston and Providence	41	$37\frac{1}{2}$	1,782,000	8	8	8	7	7
Boston and Worcester	$44\frac{1}{2}$	42	2,374,547	$7\frac{1}{2}$	$7\frac{1}{2}$	6	6	7
Lowell and Nashua	14	10	380,000			$6\frac{1}{2}$	$7\frac{1}{2}$	8
Eastern (incomplete)	60		2,267,000			5	5	6
Taunton Branch	11		250,000			7	6	$7\frac{1}{2}$
New Bedford and Taunton	21		400,000				6	6
Norwich and Worcester	$58\frac{1}{2}$		1,777,471				6	6
Petersburgh and Roanoke	60		826,000			9		6
Georgia Railroad	47		2,350,000					7
Camden and Amboy	92		2,291,802	$18\frac{2}{3}$ per cent per ann. It has earned its cost in 7 years.				6
Mohawk and Hudson	$15\frac{7}{8}$		1,000,000	7 per cent in 1840.				
Syracuse and Utica	53		893,889	pays 10 to 12 per cent annually.				
Utica and Schenectady	78		1,900,000	pays 11 per cent annually and reserves a large fund, by which it is constructing a econd track.				

The *Utica and Schenectady Railroad* has yielded, on an expenditure of $1,900,000, in 5 years and five months, the sum of - - - - - - -	$2,019,979
The whole amount of expenses during the same period, besides paying for the purchase of the Mohawk Turnpike, building 22 miles of road for turn-outs, and paying severe taxes, was - - - - -	707,694
Nett receipts in 5 years and 5 months	$1,309,285

The *Camden and Amboy Railroad.* By an *official* report from the company, it is shown that this road has earned its entire cost in seven years. It has, however, had to divide its earnings with the Delaware and Raritan Canal, with steamboats and wharves at its two extremes, costing $2,829,797,—on which it had to pay dividends, as well as to its own Stockholders, on a capital of $2,291,802, expended on the Canal, and in steamboats, wharves, real estate, and coal lands, $929,055. The canal, in fact, earning on $\frac{5}{8}$ths of one per cent.

The gross receipts over the Camden and Amboy Railroad, from 1st Jan. 1833, to 31st Dec. 1839, was	$4,637,535
The gross expenditures during this period.	$2,253,993
Net receipts in seven years - - - - -	$2,383,542

Being more than the cost of the railroad; and this too with but limited accommodations for the transportation of freight, at high charges proportioned to other railroads.

TABLE SHOWING THE LENGTH OF RAILWAYS RADIATING FROM, AND IN CONNECTION WITH, THE CITY OF BOSTON.

		Distances
From Boston, via	Albany, to Buffalo	518 miles.
do.	Portsmouth, to Portland, Maine	104 "
do.	Lowell, Nashua, and Concord	62 "
do.	to Providence, Rhode Island	41 "
From Providence to Stonington		47 "
Branch from Andover to Haverhill		25½ "
Dedham Branch		2 "
Taunton Branch, and extension to New Bedford		35 "
Bedford and Fall River		13 "
Norwich and Worcester		58½ "

New Haven to Hartford, 36, and extension to Springfield 24 miles, not completed	60	"
West stockbridge to Bridgeport	98	"
West Stockbridge to Hudson	33	"
Troy to Shenectady	22	"
Troy to Ballston	20	"
Shenectady and Saratoga	21	"
Lockport, Niagara Falls, and Buffalo	43	"
Miles,	1,203½	

INCREASE OF INCOME ON RAILROADS.

The following table proves that the assertion of the Chev. de Gerstner was correct—that Railroads which are not yet profitable may become so before long, and that those which now pay well, will hereafter produce a still higher profit.

Boston and Lowell, nett revenue,	1836,	89,800	
do.	1839,	149,100	
		$59,300	increase in 3 years.
Bost. and Worces'r. gross revenue,	1835,	119,100	
do	1839,	231,800	
		$112,700	increase in 4 years.
Baltimore and Ohio, gross revenue,	1833,	195,700	
do	1840,	432,900	
		$237,200	increase in 7 years.
Camden and Amboy, nett revenue,	1833,	181,000	
do	1839,	427,000	
		$246,000	increase in 6 years.
Liverpool and Man.'r, nett rev.,	1832,	303,000	
do	1839,	556,000	
		$253,000	increase in 7 years.

Columbia and Philadel., nett rev., 1835, 229,351
do 1840, 449,267

$219,916 increase in 5 years.

Liverpool and Manchester opened Sept.	1830. 1840.	In ten years the receipts had increased 240 per cent.
Grand Junction, " July,	1837. 1840.	In three years the receipts had increased 90 per cent.
London and Birmingham, " Sept.	1838. 1840.	In two years the receipts had increased 65 per cent.

Boston and Lowell, revenue from passengers 1837, $117,682
1840, 145,953

$28,311 nearly 5 p. ct. p. an.

Income from freight 1837, $63,137
1841, 121,588

$58,451 or 19 p. ct. p. ann.

Lowell and Nashua Income from freight 1839, $18,406
1841, 56,764

$38,358 or 70 per ct. p. an.

PROPORTION OF EXPENDITURE TO INCOME.

NORTHERN ROADS—PASSENGERS ALMOST EXCLUSIVELY.

	Miles.	*Gross Receipt per annum.*	*Expense per annum.*	*Through passengers per annum.*	*Per cent. of expense on gross receipts.*	*Dividend in 1839.*
Utica and Schenectady,	78	400,700	113,700	130,000	28	11 p. ct.
Utica and Syracuse,	53	251,200	69,300	122,000	27 1-2	11
Mohawk and Hudson,	16	150,500	68,000	188,000	45 1-4	7
Camden and Amboy,	92	685,300	258,000	182,000	39	7
		$1,487,700	509,000	Average 34 1-4 per cent.		

EASTERN ROADS—ABOUT HALF OF RECEIPTS BEING FOR FREIGHT.

Boston and Lowell,	26	241,200	92,100		38	8 p. ct.
Boston and Providence,	41	312,900	93,600		30	8
Boston and Worcester,	44 1-2	231,800	126,400		54 1-2	6
Taunton Branch,	11	58,000	40,700		72	6
Eastern Railroad,	25	125,600	53,200		42 1-4	4 3-4
Nashua and Lowell,	14 1-2	55,000	29,900		54	6
		$1,024,500	435,900	Average 42 1-2 per cent.		

SOUTHERN ROADS—RECEIPTS MAINLY FROM FREIGHT, EXCEPT THE LAST AND FIRST.

Balt. and Washington,	40	202,700	85,200	———	42	7 p. ct.

Baltimore and Ohio,	88	433,000	280,200		65	4 1-2
Georgia Central,	110	113,800	34,400		30	8
Georgia Railroad,	87 1-2	184,600	70,300		38	9
Balt. and Philadelphia,	93	490,500	164,100		33 1-2	7
		$1,424,600	634,200	Average 44 1-2 per cent.		

From the above variety of proportions borne by the *general expenses* to the gross receipts of railways, we gather that 40 to 45 per cent. would be a fair average for the roads here enumerated leaving 60 to 65 per cent. to pay interest on loans and dividends on capital. But it should be remembered also, that at very little over that ratio of expenditure, a larger business could be done, and larger profits divided. This idea will be more clearly conveyed by stating the fact, that on the Grand Junction railway, in England the cost of motive power was reduced $45,000, and the receipts at the same time increased $70,000 in the year 1840, as compared with 1839. This and some other English roads justify about the same average ratio of expenses, of 40 to 45 per cent., but they are there burthened with government dues, etc., from which our roads are comparatively free.

CAPACITY OF RAILROADS FOR FREIGHT.

To show the immense capacity of a railway, having the draw-back of grades of 50 feet, at which stationary power is used, for carrying freight and passengers, we cite the Stockton and Darlington in England, over which there passed in one year,

200,000 passengers.

690,000 tons,

principally coal, which is carried 25 miles, about, at a rate exactly equivalent to $2 per ton, for 100 miles. It makes 14 per cent. clear, and divides 10 per cent., 4 per cent. being reserved as a sinking fund. The price of the stock is £275 for £100 paid. The loads per trip carried over this road are about 65 tons nett of coal, of which they make three per day. The weight of rail on this road which has been in operation fifteen years, was originally only 28 lbs., but it has since been increased to 64 lbs per yard.

CAPACITY OF LOCOMOTIVES FOR FREIGHT BUSINESS.

Trial loads on the Reading Railroad, at an average speed of 12 miles an hour. Engine weighing about eleven tons.

1840.	Engine. 8 wheels.	No. of cars.	Bbls of flour.	Tons of iron, etc.	Tons, Nett load freight.
Jan. 8	The Gowan & Marx	57	1573	66	213
" 15	The Minerva	85	1227	72	316

1839.					
Feb. 20	The Gowan & Marx 6 wheels.	101	2002	78	268
Mar. 6	Hitchins & Harrison	88	1588	70	228
1841.					
Feb. 5	do	102	1479	104	251
Feb. 9	do	105	1318	177	308

EXPENSE OF TRANSPORTING 200 TONS OF COAL.

The trip to and from the coal mines to occupy two days—in trains of 50 cars, at 4 tons each. No allowance is made in the following calculation for back freight. Repairs of engine and cars equal to a renewal every four years.

At an average of 2½ tons of coal for the locomotive for each 100 miles, at an average of $2½ per ton, would be	$6,25
Engine driver's pay per day $2. Fireman's $1,50. Oil 1 gallon $1,	4,50
Repairs of engine per day at a cost of 8,000,	6,75
Expense of locomotive per day,	$17,50
Expense of a car per day at a cost of about $250 per coal car, viz:—attendance, one man to ten cars, $1,25 per day, is per car,	0,12½
Oil ¾ of a pint at 90 cents, per gallon,	0,9½
Repairs to a coal car per day,	0,30
Expense of one car per day,	$0,52
Daily expense of an engine as above, $17,50 per day for two days,	$35,00
Daily expense of a train of fifty cars for two days,	52,00
Total expense of locomotive, and train of 50 cars per trip,	$87,00

These expenses incidental to transportation are less than 50 cents per ton, for a run of 188 miles, without taking into consideration the *return* loads."

COST OF TRANSPORTING PASSENGERS.

The Utica and Syracuse Railroad, 53 miles long—flat bar—carried 122,000 passengers in 1840 at a *total expense* of $69,400. Equal to 57 cents each.

The Utica and Schenectady Railroad, 78 miles long—flat bar—carried 135,000 passengers at a cost of $87,400, or 67 cents each.

Note.—These charges include all expenses of repairs of Road, Mohawk turnpike, fuel, salaries, oil, etc. etc.

TRASPORTATION OF FREIGHT IS PROFITABLE.

In England, abundant proof has been furnished upon this point; but we will cite the experience in the United States, from reports made in 1840, by distinguished engineers:—"The opinion has generally prevailed that a Road to be profitable, must have a large amount of travel, and that the only source of profit is the transportation of passengers, and that, as a general rule, the freight of heavy commodities yields little or no profit. The experience so far, on our Road, demonstrates in the most satisfactory manner the *error* of this opinion. Our freighting business is more than *double* that of passengers and the mail, and this has been done under the disadvantages of having but one train for both purposes, and consequently keep up a *speed* altogether too great for the most advantageous transportation of freight."

L. O. Reynolds, *C. E. Central R. R. Georgia.*

"I can now state *with confidence*, that wherever the transportation is of a mixed character such as agricultural products, general merchandize and passengers, and sufficiently large to justify the construction of a good Railway, that Railways will be found to be not only the most expedicous, *but the* CHEAPEST ARTIFICIAL MEANS OF CONVEYANCE ALREADY KNOWN."

J. Edgar Thompson, *C. E.*
Report to the Directors of Georgia R. R.

STEAMBOAT EXPENSES COMPARED WITH RAILROAD EXPENSES.

Cost of Boat, $70,000, at 7 per cent.,	$4,900
Wear and tear, 12 per cent.,	8,400
Fuel, 220 trips, 40 cords per trip, 8,800 cords, at $5 per cord,	44,000
Insurance on 70,000, at 3 per cent.,	2,100
Oil, tiller-ropes, packing, etc.,	2,400
Wages—1st Captain, $1,500; 2d Captain, $600; 2 Pilots, $800; 2 Engineers, $1,000; 6 Firemen, $960; 10 Deck-hands, $2,000; Steward, $400; 12 Assistant Stewards, $1,440; and Bar-keeper, $400—in all	9,100
	70,900
Deduct interest on capital, to put it on an equal footing with the Railway,	4,900
Average trips per season of eight months, 220, equal to $300 per trip of 150 miles,	$66,000

The above then, brings the cost of running a Steamboat on the

Hudson River to $300 per trip of 150 miles, or at $2,00 per mile, being $1 for each passenger—Reduce the estimated expense 25 per cent., and there still remains 75 cents for each passenger.

A Locomotive and Train, equal to the same number of passengers per trip, including all expenses, and including an allowance for repair of road, but excluding interest on capital to fully cover all expenses, $80 per hundred miles, or at 80 cents per mile, being 40 cents for each passenger.

In Massachusetts the average cost per train per mile, where fuel is comparatively dear, is 85 cents. In Georgia the same average is 61 cents per train per mile, where fuel costs less.

COMPARAITIVE RISK OF RAILROADS AND STEAMBOAT TRAVELLING.

Mr. Lang, in a report to the London Board of Trade, shows by a number of facts, that Railways are the safest of all modes of conveyance, and more particularly safer than Steamboat travelling. From Jan. 1, to July 1, 1841, only three lost their lives from causes beyond their own control. Two suffered from their own folly and negligence—5 were trespassers on the Road, and the remaining 20 were engineers, laborers or workmen on the line of the Road. The number of passengers travelling was 9,122,000. The distance travelled was 182,440,000 miles. The number killed from causes beyond their own control being three, or one to 3,040,666 passengers, only one *passenger* lost his life for each 60,813,333 miles travelled.

COST OF REPAIRS FOR LOCOMOTIVES.

						cts.
Baldwine Engines.	6 on Georgia Railroad run	71,824	at a cost of	$5,453	or per mile	7,50
	12 do do	110,540	do	6,792	do	6,14
	8 Utica and Schenectady,	145,860	do	9,992	do	6,83
	6 on Columbia R. R. run	176,782	do	7,389	do	4,18
	3 on Phil. and Balt. run	48,065	do	523	do	1,08
Norris Engines.	2 on Phil. and Balt. run	44,580	do	787	do	1,76
Various manufacturers.	10 on New Jersey R. R. run	59,033	do	2,956	do	5
		656,684		33,892	average about 6 cts. per mile for *high velocities.*	

SUPERIORITY OF RAILROADS TO CANALS.

To correct the prejudice still exisiting in the minds of some persons we show the following data that Canals are more costly than Railroads.

Public documents but rarely meet the eye of the general reader

and private companies rather mystify than go into details, and the public never derive a clear idea from them. Railways and canals are alike implicated in this charge of want of distinctness in their reports.

We refer to the annexed official statement, to bring the reader better acquainted with the numerous items of expenditure on a canal, which are supposed by many to be a mere trifle. It should dispel such a delusion. And we ask of him, having first the leading features of the railway and canal well fixed in his mind, whether he is not struck with the *comparative exemption* from the ordinary causes of wear and tear of the former over the latter, and of the constant exposure of the canal to constant breaks and to be periodically swept away by freshets, while the railway is, or can be, generally placed aloof from such accidents or danger, and is never dormant, but actively employed the year through.

STATEMENT OF THE DIFFERENT HEADS OF EXPENDITURE ON THIRTY-TWO MILES OF THE CHAMPLAIN CANAL, IN CHARGE OF THOS. A. SHERWOOD, FOR YEAR ENDING 30TH SEPT., 1838.

Structures or Work.	Whole No.	Total cost. of Repairs	
Locks,	22	6,960	54
Lock tending, (exclusive of oil,)		2,112	55
Oil for locks,		42	16
New lock gates,		754	86
Waste weirs,		15	53
Culverts, cost of old estimated,		792	45
Farm bridges,	10	2,283	75
Road bridges, cost of old estimated,	9	2,840	01
Repairing scows,	5	6405	6
Lock houses, store houses, and boat sheds,	4	16	22
Timber sheds, and moving timber,		40	05
Raising and repairing tow-pate and berm bank including repairs to slope wall,		4,721	42
Cleaning out bottom of canal during spring repairs,		1,051	03
Dams,		376	99
New slope wall,		1,543	27
Docking, new and old replaced, cost of old estimated,		6,289	60
Repairs of breaches and watching canal,		269	37
Tools' shovels, picks, crowbars, axes, wheelbarrows,		1,74	91

Other works of consequence which do not come under any of the above heads.

Building two-path wall at Whitehall, between canal and creek,	5,337 56
Excavating rock and earth above and below new lock on Wood creek,	1,595 06
Excavation for deposite of streams emptying into canal at Dunham,	644 13
Building one new and repairing old crane,	314 57
Removing old embankment at Whitehall,	288 88
Building wall at Emprey's waste weir.	244 84
Repairing guard gates,	4 07
Excavating slate near Baley's,	294 88
Superintendent's salary $850, and clerk hire 199 50,	1,049 50
Miscellaneous,	866 53
Average, $1,275 per mile,	$40,809 65

The canals in Pennsylvania particularly, are more exposed to damage and delapidation than most others, nearly all of them running parallel to rapid streams. The Erie canal, exempt from this danger, has been enabled to show a better surplus, and a lower average of annual repairs, which is made only $700 to $800 per mile per annum, by the official reports from 1826 to 1838; but much has been seemingly saved since 1835 by the enlargement, the more strongly urged by its advocates on the ground of the necessity there would soon be for renewing all its *locks*, which with all canals, are fully if not more expensive than the renewal of the *sills* and *bridges* on a railway were good drainage and good care obtains. The annual costliness of the Pennsylvania canals is exhibited in the call for appropriations in 1841 by the Canal Commissioners, as follows:

General maintenance and repairs, including $150,000 estimated damage to Deleware Division by freshet of 8th of Jan., 1841,	on 650 miles canal,	$1,072,000,	tolls in 1840,		520,000
General repairs to railways, 82 Columbia and 36 of Portage,	118 " railway,	118,000,	"	"	588,000
		$1,190,000			$1,108,400

Being equal to $1,650 per mile for the canals, and $1000 per mile for the railways. Such is the contrast of expenditures and receipts, which fully refutes the claim of some that there is less wear by water than on iron; the former being always reputed among the most destructive of elements. It excites only regret, indeed,

that a system so ill adapted to the character of our country and climate, should have been so heedlessly pursued.

DEFICIENCIES IN THE NEW YORK AND PENNSYLVANIA CANALS.

New York State Canals.	*Length in miles.*	*Deficiency from commencement to 1840.*
Oswego canal,	38	268,574
Cayuga and Seneca,	23	146,497
Chemung canal,	39	241,144
Crooked lake,	8	69,817
Chenango,	97	479,560
Black River (unfinished)	38	58,711
Genesee Valley,	35	122,192
	278	1,386,495

These deficiencies include interest on cost.

Pennylvania State Canals.	*Lengths in miles.*	*Deficiency from commencement to 1840.*
Juniata Division,	130	101,075
Western do	105	1,821
Delaware do	60	51,866
Susquehanna do	39	172,523
NorthBranch do	73	327,065
Western Branch do	72	372,878
French Creek do	45	129,211
Beaver do	25	128,158
	949	1,284,597

These deficiencies exclude interest on cost.

The mode of stating the accounts, either in Pennsylvania or New York, is not very strict, as for instance in the latter State, a recent loan of $50,000 for rebuilding the wooden locks of the Chemung canal, and several other items, are charged to *funded debt*, and the new work in locks, aqueducts, etc., on the Erie enlargement, is in lieu of repairs that must otherwise have been incurred. These large deficiencies have undoubtedly been assisted by the totally inadequate business for these particular canals, but had they been railways, even of the early imperfect structure, the result could not have been so disastrous, with their quadruple resource in *freight*, *toll*, *passengers*, and the *mail*, *perennial*.

Report on Dr. Earle's Process.

Sir,—The following documents will explain themselves, as they are of a character to interest many of your readers. They are transmitted for insertion in the "R. R. Journal" by

Your ob't serv't,
Edward Earle.

"Ordnance Office,
Washington, Jan. 12, 1843."

"Hon. J. C. Spencer,
Secretary of War,

Sir,—I have to acknowledge the receipt of a letter from the Hon. R. H. Bayard, of the U. S. Senate, requesting to be informed of "the result of any experiments that may have been made under the auspices of the Department in relation to Dr. Edward Earle's method of preserving Timber and Cordage, together with the opinion of the Department, or of any of its officers, as to its practical value"—the same being referred to this office for a Report.

The great cost of Government Carriages and the difficulty of obtaining suitable timber for their construction, induced this office, early in 1840, to consider whether the interests of the service could not be promoted by the adopting of measures to prevent their decay. "Kyanizing" and Dr. Earle's process " were both duly considered, and the great expense of the former led to the use of the latter by authority of the Secretary of War. Since the Summer of 1840, about 70,000 cubic feet of timber have been cured at the Watervliet Arsenal, the greater part of which is deposited in store for future use. The exact cost of the operation cannot be stated, but it is believed to be about cents per cubic foot, and one and a half cents for the use of the patent right.

Sufficient time has not yet elapsed to prove the value of the process by the trials of gun carriages in service, but during the period of operations the person charged with supervising the curing of the timber (Mr. R. M. Bouton,) has made some experiments which are set forth in a printed paper published by Dr. Earle, which is hereto appended.

Mr. Boulton is a man possessed of much more science than is usually found in such a first rate practical mechanic, and full reliance may be placed in his statements.

Upon a careful examination of the subject, which its importance to this office, in a pecuniary view at least, seemed to demand, I have formed the opinion:

1. That the impregnation of timber with the sulphates of iron and copper may be effected by its immersion in a proper solution of those minerals at a moderate heat, and with timber of any size or length.

2. That timber thus cured will be in a great measure incorruptible, free from the attacks of worms, and from dry rot.

3. That its strength is not reduced, and its toughness or fibrous texture is improved.

4. That the cheapness of the process, united to its beneficial effects, promises a great reduction in the expenditures for such objects as are susceptible to its use, among which canvas and cordage seem to occupy a prominent place;—and, finally,

That this process will furnish the desideratum for the preservation of many things to which it is applicable, and should be patronized by the Government.

The letter of Mr. Bayard is returned herewith.

I have the honor to be, sir
Very respectfully,
Your ob't serv't
G. Talcott,
Lt. Col. Ord."

(Indorsed)

"Navy Department Jan. 17, 1843."

"I unhesitatingly express my full concurrence in the opinion and recommendation of Col. Talcott within given. I have no doubt that Dr. Earle's process might be advantageously applied to a great

variety of materials used in the naval service, and that the saving to the country would be incalculably greater than the cost. I therefore strongly recommend the adoption of Dr. Earle's process, upon such terms as may be considered fair and just between him and the country.

A. P. Upshur."

Report.

At a meeting of the President and Managers of The Philadelphia and Reading Railroad Company on the 4th day of January, 1843, the following Report was presented, approved, and ordered to be printed for the use of the Stockholders.

To the President and Managers of the

Philadelphia and Reading Railroad Company:

Gentlemen,—In accordance with your resolution of the 10th inst., I have the honor to present to you the following Report:—

The entire line of the railroad, between Philadelphia and Mount Carbon, as the Board are aware, was opened for the transportation of freight and passengers, on the 13th day of January last; and on the 17th day of May following, the branch for the accommodation of the coal trade on the Delaware was opened to the Company's wharves at Richmond.

On the opening of the road to Mount Carbon, the transportation of coal was commenced, which increased on the completion of the Richmond branch until limited by the number of cars and engines then owned by the Company. A contract was entered into on the 3d of March, for one thousand coal cars, a large portion of which it was expected would have been delivered in time for the fall trade; and contracts were also made with several different establishments for engines sufficient for their transportation The coal cars to be furnished under this contract, were not received as early as had been anticipated by the Board, and some of the engines are still undelivered. The consequence was, that the force on the road was entirely inadequate to the trade that offered. In addition to this, although the main line of the road was completed, there were numerous additions, such as extra tracks in the coal region, and at Richmond, proper connections with the branch roads, and *sideings*, for the passage of the trains on the road, etc., which were in an unfinished state during the past season, and the want o which would have been as insuperable a bar to a large business, as the want of cars and engines.

In the month of August, when the force on the road was being rapidly increased, and there was a prospect of realizing, to some extent, the expectations of the friends of the road, the operations of the Company were suspended by the destruction by fire, first of the bridge across the Schuylkill at the falls, and shortly after of the bridge across Mill Creek. These structures were rebuilt, and the trade to Richmond recommenced on the 13th of October, and from that time until the close of the shipping season, a regular coal business was done, to the extent of the cars and engines on the road.

Some disappointment has no doubt been experienced by the Board of Managers in consequence of these vexatious interruptions and delays in commencing the transportation of coal, but to some extent they were reasonably to have been expected. The contractors for building the coal cars

were energetic and efficient men, and did all in their power to complete them as speedily as possible; but it was not probable that they could obtain the requisite amount of timber, of suitable description, for so large a contract, much, if at all within the time which their contracts admitted; and experience has shown, that we cannot always rely on our locomotive builders, for the delivery of engines within the time specified by their agreements.

These difficulties, it is believed, are now to a great extent overcome. The road between Reading and Mount Carbon, which, from having been laid in the *winter*, was not in as good condition as could be desired, has been greatly improved, and the whole line of track from Mount Carbon to Richmond, and to the Columbia Railroad Bridge, is now in good condition. The bridges throughout the line, have been thoroughly examined, and every thing done which seemed likely to add to their permanency and durability; they are now in good solid condition with the exception of the one across French Creek, at Phœnixville, which, in consequence of the spans being increased beyond what was anticipated at the time of framing it, has proved less permanent than the rest. Such improvements are now being made to it, as will give it the required strength. In rebuilding the bridge across the Falls of Schuylkill, only about one-third was rebuilt on the original plan, the balance being of trusswork, supported by the piers and intermediate trusses. The timber for rebuilding, permanently, this portion of the work, is now being delivered, and will be speedily framed and in readiness to raise, but the present structure will stand any ordinary freshet. During the past summer, the track has been doubled at four suitable points, for a sufficient length to pass *two* of the longest coal trains at each point, affording with the double tracks previously laid, accommodation for the passage of ten or twelve trains per day in each direction. Additional tracks are being laid at Schuylkill Havan and at Richmond, and thetrusswork is being built on four additional wharves, so as to afford every facility for speedy shipment. Arrangements are also making for some additional water stations, which will probably be required by the trade of next year, and for increasing the capacity of those already built, by the introduction of constant streams, wherever they can be commanded at any reasonable cost.

There are at present on the road twenty-four engines, (eight of which are calculated for passengers and light freight, and sixteen for coal, etc.,) and eleven hundred and thirty coal cars. The engines are sufficient for a business of six trains or about one thousand tons per day. In addition to these, a contract has been entered into with the Locks and Canals Company of Lowell, Mass., for twelve engines and four hundred and fifty coal cars, which are progressing rapidly, and will probably be delivered in the course of next spring. When this contract has been completed, together with two engines now building, and nearly finished, by the New Castle Manufacturing Company, the force on the road, for the transportation of coal, will be thirty engines and fifteen hundred and eighty cars, equal to about ten trains, or a business of about 1600 tons per day. This, it is thought, will be about as large a business as can well be accommodated, until some continuous portion of the track can be doubled; and it is extremely desirable that this should be done as soon as the arrangements of the Company will admit of it. If a double track was laid between Reading and Pottstown, a distance of eighteen miles, (of which *two* are already laid,) the trains from each end of the line could be passed in this distance, and not only would the capacity of the road be greatly increased, but the delays and irregularities which the best management on a single track cannot al-

ways prevent, would be avoided. The increased number of engines on the road will render it necessary to add to the workshop at Reading in the course of next summer. The present building was erected with a view to its extension whenever the trade on the road should require it.

From the causes mentioned in the beginning of this Report, the coal business done on the road during the past year has been much less than was anticipated, but nothing has occurred at all calculated to shake the opinion formed of its capacity, as to the amount of business that can be done, or the cheapness of transportation over it. The greatest number of coal trains yet passed over the road per day is five in each direction; a small number, it is true, compared with the anticipated trade of next year, but these were all passed at one point (Reading,) and the double track, now laid, will admit of the passage of at least double that number with nearly equal facility. The performance of the engines during the past year leaves no doubt of their being fully equal to their estimated power, their usual loads being from one hundred and sixty to two hundred tons. The experience of the past year also confirms the opinion that the cost of transporting coal from Mount Carbon to Richmond, will not exceed 50 cents per ton; at present it would appear to be less, but allowance is to be made for the cars and engines being new, and requiring less for repairs than they will after having been some time in use.

The amount of the receipts of the road for the year ending 31st December, 1842, as near as can at present be ascertained, are about $200,000, and the expenses for the same period about $118,000. A general and detailed statement of the working of the road, amount of business done, etc., will be made out and presented to the Board, but cannot be completed in time for the meeting of the stockholders.

From the preparations now making in the coal region, and the great demand for the Company's cars during the past year, there is every reason to believe that when the shipping season commences, there will be few, if any, of the unemployed at the rate of freight now charged; should this be the case, 300,000 tons would seem a very safe estimate for the amount of the coal business of next year. The receipts of the road for the past year, from sources other than coal, are about $140,000, and as it is the first year since its opening to Mount Carbon, and has been one of extraordinary depression in all kinds of business, it is probable that the receipts from the same sources for the next year will not be much less than $200,000. Should this estimate of the business of next year be correct, the receipts of the road would be about - - - - - $630,000

Probable expense for the same period, - - - 220,000

Probable nett receipts for 1843, - - - - $410,000

A statement of the number of cars, engines, etc., now on the road, and of those contracted for but not yet delivered, is herewith presented.

I have the honor to be,

Gentlemen,

Your ob't. serv't,

WIRT ROBINSON,

Engineer and Gen. Supdt. P. & R. R. R.

December 31*st*, 1842.

Cost of Transportation on Railroads. By C. Ellet Jr., C. E.

ON THE VALUE OF TIME.

In estimating the cost of transportation on railroads I have taken no account, in the preceding numbers, of an item which is generally considered of great consequence in determining the result; viz. *the value of time.* Speed is the peculiar advantage of railroads, and one which is certainly sometimes deserving of much consideration in the administration of the work. I propose to estimate its real value, as nearly as it can be done, in the transportation of passengers and merchandize.

First, then, what are we to regard as the measure of the value of time on any article of merchandize? Is it not the interest on the capital invested in the commodity, at the rate at which the proprietor estimates his profits for the time, added to the rate at which his goods depreciate in value in consequence of detention on the route?

If this be true—and I cannot well perceive what other value than this the *time* lost in their conveyance can possess—let us endeavor to ascertain to what it will amount under different circumstances; and for this purpose we will represent by

r the rate of interest, and depreciation of the value of the goods, per cent. per annum;

P the value in dollars of one ton of the commodity; and

V any velocity of transportation in miles per hour.

There are 8760 hours in a year; and if we represent this number by m, the interest and depreciation of the value of a ton of goods, in the space of one hour, will be expressed by

$$\frac{\mathrm{P}r}{100m};$$

and during the time the goods are carried one mile at the velocity V, it will amount to the sum

$$\frac{\mathrm{P}r}{100m\mathrm{V}}.$$

This interest and depreciation, for any other greater velocity V′. will be for the time consumed in traversing one mile

$$\frac{\mathrm{P}r}{100\,m\,\mathrm{V}'};$$

and, consequently, the difference between the values of the two velocities V and V′ (supposing that the time and speed be well employed, and that the engine drivers do not waste at the stations and depots what he gains on the route,) for each ton and for one mile, will be

$$\frac{\mathrm{P}r}{100m}\left(\frac{\mathrm{V}'-\mathrm{V}}{\mathrm{V}'\,\mathrm{V}}\right). \qquad \text{(K)}$$

This expression represents the amount which the goods would depreciate while passing over one mile, at the velocity V, over and

above their interest and depreciation while traversing the same distance at the velocity V' ; or the additional sum which the owner of the goods would be willing to pay to have them carried at the speed V′ instead of the slower rate V.

Now let us apply this equation to the transportation of coal, and assume for the velocity V′ that which would be likely to have place on a railroad, or ten miles per hour; and for that of V the ordinary speed of a canal boat, or two and a half miles per hour; for the value of the commodity, *three dollars* per ton, and for the value of the capital employed in the trade, 20 per cent. per annum.

How much per ton per mile would the value of a speed of ten miles per hour exceed that of two and a half miles? By the equation we have here

$$\frac{3+20}{8760 \times 100}\left(\frac{10-2.5}{10+2.5}\right)=\frac{1}{48666}\text{ of a dollar,}$$

or a fraction more than the fiftieth part of one mill per ton per mile. It would appear, then, if this process be correct, that their is but little encouragement to tear the road, and oars, and engines to pieces—augment the risk of accident, and increase the actual cost of transportation 100 per cent.—for the purpose of delivering coal a few hours sooner than it might be effected on a canal at a speed of two and a half miles per hour. If the value of the coal be not more than three dollars per ton at the mine, and the value of the capital engaged in the trade not more than 20 per cent. per annum, the difference to the proprietor could not amount to more than the *fifth part of one cent per ton for the whole time consumed in traversing a space of* 100 *miles.*

Again, let us suppose that the article is flour, of which the value is six dollars per barrel; and let us, at the same time, assume that the depreciation would be 100 per cent. per annum: which is equivalent to the supposition that it would be entirely destroyed if it were detained one year on the passage, and that the depreciation is uniform during the whole period. We will also suppose that the speed on the railroad is infinitely great, or that a mile might be passed by a locomotive engine in a space of time so short as to be wholly inappreciable; while the speed with which the same article would be transported on a canal is, as usual, two and a half miles per hour.

What is the value of the time lost on the canal in this case? Here we have $r = 100$, $P = 6$, $V' =$ infinite, and $V = 2\frac{1}{2}$; which quantities being substituted in the equation yield

$$\frac{100 \times 6}{8760 + 100} \cdot \frac{1}{2\frac{1}{2}} = \frac{1}{3650}\text{ of a dollar,}$$

or about the *fourth part of one mill per mile per barrel.*

This will be recognized as rather an extreme case; but still it does not justify a high speed,—for three mills per ton per mile is generally not very perceptible among the quantities which enter into the aggregate expenses of a railroad line.

Let us next suppose the commodity to be groceries—such, for

instance, as sugar and coffee—of which the value may be assumed at two hundred dollars per ton; and that the interest and depreciation are equal to 20 per cent. per annum. In this case will find for the difference between the value of a speed of ten miles per hour, and one of two and a half miles per hour—between the speed of a locomotive and that of a canal boat,

$$\frac{200 + 20}{8760 + 100}\left(\frac{10-2\frac{1}{2}}{10+2\frac{1}{2}}\right)=\frac{1}{730} \text{ of a dollar,}$$

or about *one and a third mills per ton per mile.* The difference between the value of a speed of five and one of ten miles per hour, would not in this case have exceeded a half mill per ton per mile.

A high speed, then, is not justifiable in the transportation of groceries for the purpose of saving time in the delivery of the freight. If it be adopted at all it must be because the condition of the road, or some other part of the business which it accomodates, renders it imperative, or because the injury which the work sustains in consequence of the greater velocity is not properly appreciated by the parties in control of the line.

We will next take the case of dry goods, of which the average value may, perhaps, be assumed at 2,000 dollars per ton; the interest and depreciation will again be put at 20 per cent., and the respective velocities at two and a half and fifteen miles per hour.

By the formula we have, in this case,

$$\frac{2000 + 20}{8760 + 100}\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right)=\frac{1}{66} \text{ of a dollar,}$$

or one cent and a half per ton per mile.

This sum is nearly equal to the actual cost of transportation on a road in good condition; and it is therefore apparent that in the conveyance of trains composed exclusively of the most valuable goods, a greater velocity than two and a half miles per hour is always proper; but when it is recollected that there is never more than a very small proportion of the merchandize passing over a line, which possesses anything like the value here assumed—2,000 dollars per ton—the adoption of a higher velocity must still be regarded as of very doubtful utility. Even in the case pefore us—where the value of the goods is assumed at 2,000 dollars per ton—the difference between the value of a speed of fifteen miles per hour and one of six miles per hour would not amount to a half cent per ton per mile—a sum which would by no means justify a higher speed even if the train were loaded entirely with such goods.

If we apply the same method of computation to the conveyance of passengers, and estimate the average value of the time of all the individuals in the trains, at twelve cents per hour, we shall have for the difference between the value of a speed of fifteen miles per hour and the usual speed of freight boats on canals, or two and a half miles per hour,

$$12\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right)=4 \textit{ cents per passenger per mile.}$$

If the average time of all the individuals travelling be worth

twelve cents per hour, the charges on a road where a speed of fifteen miles per hour is adopted, *may be four cents per mile higher than could be demanded on one where a velocity of only two and a half miles per hour is maintained.* Of course there is a great difference between the values put on their time by different individuals; and of course too, there must be much uncertainty in fixing upon a general average. But twelve cents per hour (including the expenses incident to the trip) is by no means a high estimate for the time of all the individuals travelling in the public conveyances; but yet, low as it is, it shows for the value of the time of one person—exclusive of what mere impatience would prompt him to pay—a sum nearly two thousand times greater than that of a ton of coal, thirty times greater than that of a hogshead of sugar, and nearly three times that of a ton of ordinary dry goods, transported at the same rate.

We may perceive, then, why the superiority of railroads is so much greater in the transportation of passengers than of heavy freight; and how it may happen that a velocity which is in the highest degree economical when adopted for the convenience of travellers, may be ruinous when applied to the transportation of minerals and produce. Indeed it is difficult to over-estimate the injury which is inflicted on the interests of stockholders, from the continuance of this evil in the management of railroads, although it has been materially abated within the last four years. The value of the additional time which is consumed at the slower rate is absolutely unworthy of consideration in the conveyance of merchandize; and the only question which ought to occupy the attention of the directory is the reduction of the actual expenses of the line, and the selection of that velocity which corresponds with the greatest possible economy. The great and constant effort should be to reduce the cost of transportation to the lowest limit. It is not railroads nor canals that increase the trade of a country or add wealth to the districts which they traverse. It is the reduction of the charges for conveyance which these improvements permit, from which these great advantages are derived. And high speed on such commodities offers no compensation for the high charges which it axacts.

These considerations are applicable only to the value of time on the goods transported. But the loss of interest, and depreciation of the value of the freight, are not the only losses involved in the adoption of an insufficient speed. The value of the time of the *train, and of the train hands,* is also to be considered, and enters into the complete expression of the actual cost of transportation. If the engines and cars, and the men who conduct them, do less duty than they might accomplish by the adoption of a higher velocity, the value of the time of the increase of stock and force which will be required to effect the same duty at the slower rate, must obviously be charged against that velocity.

It is true that there are cases in which the speed to be adopted is governed by the necessity of accommodating a certain amount of

trade, or making room for a large passenger conveyance, which could not be adequately provided for on a single track, without maintaining a speed determined by the circumstances. Of course the company must submit to this necessity; they must adopt a high velocity where these or other imperative conditions exact it. But the question now is, what is the value of velocity or time, where they have the power to exercise their own discretion in the selection of the speed?

In all such cases the slower the motion of the train the less will be the expenses of the company, unless it be reduced so low that the interest on the cars and engines which convey the freight, and the loss of the time of the engine and train hands, more than compensates for the reduced charges for repairs of the road and machinery.

We will designate by F the value of the locomotive engine in dollars; by f the value of the stock in cars for each ton of freight; by m' the value of time of all the hands in the train for one hour; and by q the number of tons of merchandize in the train.

The value of one hour for the whole train will be, at 6 per cent.

$$\frac{6}{100\,m}(\mathrm{F}+fq)+m'; \qquad \text{(L)}$$

and if we represent this quantity by H, the difference between the values of the velocity V′ and that of V, will be for each ton, and for one mile

$$\frac{\mathrm{H}}{q}\left(\frac{\mathrm{V}'-\mathrm{V}}{\mathrm{V}'\mathrm{V}}\right). \qquad \text{(M)}$$

This is the difference per ton per mile to the company between the values of these velocities, where no imperative conditions obtain.

Now let us see what value this expression exhibits under different circumstances: and for this purpose we will put $\mathrm{F}=5000$; $f=100$; $q=50$; $m=8760$; $m'=\frac{1}{4}$, all which are very common values, and suppose, in the first instance, that the business of the line may be transacted by an adequate supply of engines, men and cars, at some exceedingly slow rate—as half a mile per hour—how much more would it cost the company, in the value of time, to carry the trade at this rate, than at a speed of ten miles per hour?

Equation (L) gives us

$$\mathrm{H}=\frac{11}{40}\text{of a dollar},$$

for the value of one hour of the time of the train. This value of H being substituted in equation (M) will yield,

$$\frac{11}{40+50}\cdot\frac{10-\frac{1}{2}}{10+\frac{1}{2}}=\frac{209}{20000}\text{of a dollar},$$

or more than one cent per ton per mile.

Now, in this case, the value of the time of the train, exclusive of the goods, is equal to half the actual cost of transportation on a well managed road with ample trade; and it is perfectly apparent

that, even overlooking the loss of time and depreciation of the price of the *goods*, such a rate is wholly inadmissible. But let us apply the equation to the determination of the difference of value of a speed of five miles and one of ten miles per hour, under the same circumstances. In this case equation (M) gives us

$$\frac{11}{40\times 50}\cdot\frac{10-5}{10+5}=\frac{11}{20000}\text{ of a dollar,}$$

or only one half mill per ton per mile—or less than the tythe of the actual difference of cost—consequent on the destruction of cars, engines and track—risk of accident and damage of goods, incident to the adoption of the greater velocity.

The whole difference between the value of a speed of five miles per hour and one of ten miles per hour, will rarely exceed one mill per ton per mile, in its effect on the interest of the value of the train, together with the depreciation of the value of the goods conveyed. However great, then, may be the inducement to carry passengers at a more rapid rate, there is no sufficient cause for transportating freight at a speed of more than five miles per hour, unless, as already premised, a higher rate is absolutely essential for the accommodation of all the trade which is commanded by the line—a condition which, on ordinary roads in this country, very rarely prevails.

We are not likely to overrate the injurious effect, or too strongly to deprecate the continuance, of the mischievous practice which still prevails in this country in the transportation of heavy commodities. The iron rails are rapidly destroyed by it; the wear and tear of the cars and engines are greatly augmented, and the useful effect of the power applied is materially reduced. There is no corresponding advantage obtained. The value of the time which is saved is almost too small to be estimated for the freight, and the value of the time lost by the train bears no perceptible proportion to the injury which is done to the road and its furniture.

Extract from Address

Delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; by A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

Prussia has undertaken to show what an "enlightened despotism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding and the culture of the beet, and the manufacture of sugar from it.

The minutiæ to which the government descends, may be perceived from the fact that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts, is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is commenced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers, have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well educated young men, whose influence on the occupations which they embrace, must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States of Germany, once loosely connected by political ties, in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines (or models of them) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various

kinds and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if one day a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Philadelphia.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world--a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts—and as entering the spacious gates, he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories only rivalled by one among ourselves, through the extensive range of rooms for the display of the materials of the arts, of models, of fabrics, of machines—through the work-shop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this* at least the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that in the arts depending upon chemistry the existence of that institution has already produced important effects, and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede or follow the theoretical instruction of the schools, is a moot-point, An intelligent iron master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there—and in Dresden, the apprentices who are pupils of the Saxon Trade School, work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice

We may admire the efforts of the Austrian and Prussian commission, but after all, the plodding spirit of routine which clogs the limbs of activity in these countries, renders the measures of success of the plans *there*, no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom

are doubtless not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons —do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending as it does through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of Great Britain. If an Englishman's house is his castle, his workshop is its citadel. The establishment of Bolton & Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh cares little whether the colors of his dyes suit the "Glasgow folks" or the "Edinboro' gentry" or not, and Strutt does not make his woolens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbor—to keep, as far as he can, the ascendency which skill, or talent, or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions and collections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity —by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners, and address, for the striking reverse trait

which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences and to add numbers. Away with such limited views of education! Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth any thing, it is worth carrying to its full consequence. Because Burnet was brought up a blacksmith Lukens a farmer, Baldwin a jeweler, Merrick a merchant, and Merris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines and machine makers by apprenticing them to the details of filagree work, of accounts, or of pharmacy. This seems the ligitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson, of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his apparatus and a small legacy to found a more liberal school. Dr. Birkbeck endeavored to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprung up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, etc., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very pop-

ular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures, explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiences and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce esprit de corps. The results are of inestimable value in the aggregate.

The low wages of operatives generally in Europe, low relatively to the prices of conveniences, tends to keep the mass of them from intellectual improvement. Their youth is passed before they can judge of the necessity for culture, and when manhood is reached, the cares of providing food and maintenance for themselves, and usually for a family besides, press upon them so heavily, that they have time to think of little else. Until the means of life are more uniformly distributed, the mass of the mechanical population of Europe cannot become intellectual. The advantages of a different system of things, which exists with us, we should never lose sight of—never let go. It is not true that the necessaries and comforts of life are higher with us in the same proportion as our wages. The life of the American working-men is not that of the European. Besides that his inestimable political rights put him on a par as a citizen with every other citizen, he occupies a different place in the social scale—may, by education in school and out of school, put himself on an equality with any other citizen—and may have comfort and competence for himself and family. Thus relieved from the grinding pressure of want, wo to him if he slight the privileges bestowed by a bountiful Providence! Wo to him if he forget that he has a mind and soul as well as a body—an intellectual and moral as well as a physical nature!

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and their cultivators,* have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures, and the arts, exist all over our country, not supported, it is true by our great sovereign,

the people, but by a few, who are either immediately or remotely interested or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time, the commons of England gave every ninth sheep and every ninth fleece, to their ruler, to enable him to wage war; now a large portion of our commons devote at least the ninth penny to king Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue.

In different parts of our country, the modes of action intended to accomplish the great ends to which I have referred, have been various, and attended with very different degrees of success. It will be more proper, as well as more profitable, to look specially to our own doings.

TO BE CONTINUED.

SELECTIONS FROM FOREIGN JOURNALS.

Eruption of Mount Etna.—This Volcano after a rest of several years has again given signs of great internal commotion. In November the usual prognostics, the drying up of the springs, and the smoke, gave an intimation of what was about to take place. The flames were seen at Palermo, a distance of ninety miles in a direct line. No lava has yet been thrown out.

Novel Artesian Well.—An experiment is now making at the head of the Brighton chain pier, by which it is intended to obtain fresh water from below the ocean. It is expected that at the depth of seventy feet the chalk formation will be reached and fresh water obtained.

Keene's Marble Cement.—This is a combination of plaster of Paris (Sulphate of Lime) and alum. Common *boiled* plaster is steeped in a saturated solution of alum and then re-calcined and reduced to powder when it is fit for use. Although not capable of standing weather this substance is now attracting much notice from the beautiful stucco which it forms, resembling marble. It may be colored by simply mixing the color with the water used in applying it. The hardness of the substance and its beautiful polish, have brought it into use for interior decoration.

The Great Northern Steamer.—This vessel built at Londonderry is upwards of 1500 tons burthen and is fitted with Smith's Screw propellers, driven by engines of 350 horse power. She is rigged in all respects like ordinary vessels of similar size, and the steam power is considered as merely an axiliary to be used in calms, head winds etc. This mode of using steam upon the ocean, seems destined to become far more general and for most purposes more economical than the use of steam vessels as generally built.

AMERICAN

RAILROAD JOURNAL;

AND

MECHANICS' MAGAZINE.

No. 2, Vol. X.] New Series.] FEBRUARY, 1843. [Whole No. 422 [Vol. XVI.

We are again indebted to Mr. Jos. E. Bloomfield for an analysis of the annual return of the Massachusetts Railroads.

This is the sixth year for which these tables have been made, and each is of increasing interest as containing the result of more experience.

For the American Railroad Journal and Mechanics' Magazine.]

In presenting you with the 6th table of the annual receipts, expenses, dividends, and cost, of the railways completed in Massachusetts, compiled from the reports of the several railroad companies, for the last six years, to the Legislature, it is to be regretted there are so few new features to remark on. They have pursued a legal form in their returns, without reference to detail, and the working of their roads. The reports however of the *Western railroad—Eastern railroad,* and *Norwich and Worcester railroads,* give us tabular details, highly interesting. The cost, and *working of* the Western railroad, is placed under the several heads, so repeatedly asked for in your valuable Journal.—Their publication, and the form of the table of the superintendents department of the Norwich railroad are models for imitation.

It will be perceived, the cost of the Western railroad to Albany from Worcester, is $7,566,791 for 156 miles of road—with 14 miles of turnout—equal to $48,500 cost per mile.—The Boston and Worcester railroad 44½ miles, has cost $2,726,102.—Total cost of 200 miles of road $10,292,893. On this road, there were great deficulties to conquer, from the nature of the ground, runing as the line

does, at right angles, with rocky, mountain summits.—One is east of the Conneticut river, at Carlton, 906 feet above the *base* line of the Boston and Worcester railroad in Boston, the other, at Mount Washington, between the Conneticut and Hudson Rivers 1456 feet along the same base line at Boston mill dam and 1480 feet above tide water.

The desire to press forward a large expenditure, to accomplish the wish of the statesmen, who planed this magnificient work, has caused many extra expenses. This is perceived in the cost of depots, and of land for the *right* of *way.* Also in the item of engineering, amounting as it does to $263,105 or near $1700 per mile. The item of land damages, with depots and Stations, consisting of 1648 acres of which 118 acres are for 29 depots, has cost $339,716, exceeding $200 per acre, for 10½ acres to the mile.

This land, for farming purposes, cannot be valued on an average, to exceed $50 per acre. It has been greatly exchanged in value, by this road, affording a ready market for agricultural and manufactured products, yet we find, that the location, prior to the obtaining of releases, or terms, and hot haste with which the work has been forced through, has cost the company $2163 per mile, for "depots, and the right of way,"—although it was considered, at the commencement of the work, that ample grounds had been taken for depots at Springfield and other points, yet the report states "they were found insufficient." At Greenbush, in front of Albany, twenty-one acres of land with 1600 feet of front on the Hudson River, have been secured, and a canal excavated along side of a Brick ware house 420 feet by 90 feet, with other commodious buildings, and wood sheds. Thus in order to manage with economy the business that will naturally be drawn to this important avenue from the grain and provisions districts of this state, to manufacturing New England and her web of railways.

The results, the first year, after the completion of the Western road to Albany, speaks much for this work. With a deficient *motive power,* in proportion to the business offered,—also with 15 miles of the Hudson and Berkshire railroad, an inferior road, and expensive to operate,until their road was completed,the following receipts must cause surprise even to its friends. It is an earnest of the business " the directors look forward to this year" *on the opening of our Canal.*

They have received for 18,570 *through,* and 271,866 *way* PASSENGERS (the receipts from the way being nearly as on 1½ to 1, or $173,566 way, to $92,850 through) the sum of $266,446.

There were 6,211,971 tons *nett*, transported one mile, equal to 39,820 tons carried over the whole road, 156 miles, or, equal to 1026, through trips with $38\frac{3}{4}$ tons per trip, this amount is about half the capacity of the freight engines, over grades of 83 feet.

There were sent from the Greenbush station, Eastward 170,615.

Barrels of flour, weighing	18,341 Tons		
Beef, Pork, Butter Cheese etc.	12,347 "		
Tons	30,688 "		
Tonnage from Boston and other places going West	9,132	producing	$246,242
Total freight and passengers,			$512,688

The expenses of this business (which includes $48,992 for repairs to the road, and to keep the same in permanent condition) is 52 per cent of the receipts, $256,619

This rate is moderate, compared with the commencement of other roads in New England. The Locomotives on this road, have run 397,295 miles at an expense of only 67 cents per mile. This result, with such heavy grades, and with the difficulties they have had to overcome, attendant on a new work, reflects great credit on the Directors and agents, and gives, as they truly say, "great promise for the future."

There is another and striking view, of the amount of receipts over the Western railroad, compared with the receipts of tolls on our Erie and Champlain Canals after their completion.

The comparative cost and receipts of tolls, the first year after, the completion of those works, 450 miles in length with their feeders, is as follows :—

The cost of the Boston and Worcester railroad	$44\frac{1}{2}$	miles,		$2,726,102
The Western railroad,	117	"	$5,814,807	
The Albany and West Stockbridge,	$38\frac{1}{2}$	"	1,751,984	7,566,791
Boston to Albany,	200	miles, cost		$10,292,893

The cost of the Erie and Champlain Canals	450	miles, was within	$8,000,000

The entire receipts from *Freight* and *Passengers* 1842

over the Bost. Worcester	$175,674	$186,610	
The Western & Albany	$246,242	$266,446	$874,981

The tolls the *first* year, after the completion of the Erie and Champlain Canals, were - - - $566,112

The fourth year, the tolls were $795,056. The expenses for repairs, agents and collectors have averaged about $1000 to 1200 per mile per annum on the New York Canals.

It is understood that Massachusetts has about $22,000,000 invested in railway stock in that State. The railroad investments in Rhode Island, Maine, New Hampshire and Conneticut equal $5,000,000 additional.

It has been represented that Boston owns half of the stock in the line of railways, from her state line to Buffalo, a distance of 364 miles. The cost of this line may be estimated at $20,000 per mile or $7,200,000.—New England therefore has $31,000,000.—judiciously, invested, producing on an average of 6 per cent, per ann. after ample allowances for renewals, steadily improving.

This view is warranted, on examing the result of the average income, for the last six years of the three first constructed railways, radiating from Boston. These roads are too short for economy in their management. They were built in 1832-3-4 a period when labor was very high. They could now be constructed for about half what they then cost.

	Length	Cost	Expenses for 6 years	Receipts for 6 years	Dividends 6 years	Average for 6 years
Boston and Lowell	26	1,834,893	588,127	1,391,196	46 p.c.	7,66
Boston and Providence	41	1,782,000	847,852	1,499,794	42 "	7
Boston and Worcester	44	2,374,547	778,666	1,594,825	41 "	6,85
Miles,	111	5,990440	2,214,645	$4,485,815	Average	7,15

The several railroads from the Hudson to Buffalo in this state, yields from 6 to 12 per cent., with the exception of the Mohawk and Hudson railroad.

The Canals first constructed in New England, have comparatively, all gone into disuse. This will be the case with the latteral Canals, in this state, on the introduction of good railways. The Erie canal from its peculiar location, connecting inland seas, with the Sea Board, on a remarkable throughfare, will be an exception. The policy of enlarging this work, is beginning to be questioned, even in the Western district through which it passes. The *glory* of the undertaking, heretofore carried the Eastern, and Western counties in favor of the project, without due consideration, any correct estimate of its cost, or its use, to cheapen transportation, when completed.

It may reasonably be expected, that the farmers and traders of our own state, who witness the success of Massachusetts, in carrying all classes of *bulky produce*, at from 2 to 5 cents per ton per mile, and Passengers, at from 1 to 2½ cents per mile, will not permit *the state to monopolize transportation*, for only seven months in the year, —thus excluding them from the seaboard market for provisions in the winter,—the best, both at home and abroad. This too, at a period, when for pleasure, and with profit, the farmer can attend to his own sales, and purchases. If our state restriction on railways to carry freight is taken off, every month in the year, will be a business month.

A smaller capital will enable the merchant and trader, to do a a *safer*, more *certain*, and more profitable business, than formerly.

The system of railways, marked out from New Orleans to Portland in Maine, and the actual completion of a continuous line of 640 miles of road from Portland, to Buffalo on Lake Erie, will when extended, through Ohio to St. Louis, prove the best regulator of domestic exchanges. Railroads are destined to equalize the value of the currency, at all points of the Union. As a means of defence, they require the fostering care of the War Department, and patronage of the Post Office department.

In closing these remarks, which I have been obliged to run off hastily for this number of your Journal, it is proper I should mention, that since the last report, the Boston and Lowell, and Lowell and Nashua railroads, have been extended to Concord in New Hampshire. The Berkeshire railroad, 21 miles from the Housatonic railroad, at the Massachusetts South line, has been completed to Stockbridge, and *put in operation*, for the moderate sum of $205,-000. The Eastern railroad, has been continued from Portsmouth to Portland, during the last year, while the construction of the line in Connecticut from Hartford to Springfield, 25 miles, has been secured, thus proving that the march of the railway cause, in *calculating New England*, where the extra sagacity of the people is proverbial, is onward.

The fate of the Farmington, the Blackstone and the Middlesex canals, should be a beacon to deter us in this state, from the construction of any more latteral canals. We should profit by the eloquent, and true passage, taken from a report to the Legislature of Massachusetts in 1839, made by a select committee, when having under consideration, aid to the Western railroad.

The report states, "Railways have universally created the means of their own sustenance, and have drawn to their tracks, employment for their motion. If the beneficence of Providence, had hollowed a channel from Boston to the Western Lakes, and poured the floods of those inland seas, eastward to the Ocean, the blessings would have been too great for sufficient gratitude, as they would have been beyond all computation. The river, swelled by tributary streams, from every valley, would have scattered wealth along its course. For all practical purposes, the invention of art, bestows better advantages, and furnishes communication made more easy and certain, than the bounty of nature could give. During the stern winter of our climate, the rivers are closed one third of the year with ice, in summer they are exhausted for nearly an equal period; their navigation is bounded by the hills that supply their fountains. The railway is neither locked by cold, nor dried up by heat, nor confined by ridges,—streching out its arms to every town and village, it may be extended beyond the highland barriers of water passage, and beyond the Lakes, until its iron bands clasp together in a net work of improvement, overspreading the whole Union."

Very Respectfully,

JOSEPH E. BLOOMFIELD.

TABLE

Of the Cost, Receipts, Expenses, Income, and Dividends of the Railroads in Massachusetts, compiled from the Annual Reports to the Legislature, of January, 1843, *made by the several Corporations, under oath. Also, a Comparative View of the Dividends, Expenses, and Receipts of the Boston and Lowell, the Boston and Providence, and the Boston and Worcester Railroads, for the years* 1837, 1838, 1839, 1840, 1841, *and* 1842, *inclusive; and of the Nashua and Lowell, and Taunton Railroads, for four years. Prepared, by request, for the "Railroad Journal," by* JOSEPH E. BLOOMFIELD.

NAME OF ROAD.	Date.	Length.	Expended in cost of road.	Rep'rs of engines and cars.	Rep'rs of road.	Rep'rs en'gs & cars per mile.	Rep'rs of road per mile.	Fuel, oil, salaries, and incidental expens's.	Total expenses.	Total receipts.	Income from passengers.	Income from freight and the mail.	Dividends per ann.	Miles run.	Cost per mile run ex. of interest on capital.	Maximum grade.	
Boston and Maine	1842	58	1,260 285	8,169	8,693	141	150	35,099	79,278	155,880	109,681	46,199	6	152,454	52 cts.		
Boston and Lowell	1837			16,633	14,056	650	546	33,424	78,508	180,770	117,643	63,137	7				
do do	1838			10,945	15,734	421	611	48,917	75,597	191,780	109,083	82,697	7				
do do	1839			16,384	18,843	636	731	56,923	92,151	241,220	135,037	106,131	8				
do do	1840			14,455	21,013	561	816	55,932	91,400	231,575	127,008	104,567	8				
do do	1841			22,644	33,193	870	1,200	63,631	119,469	267,641	145,953	121,588	8	125,300	81 1-4	10	Double track.
do do	1842	25¾	1,978,286	28,816	34,972	1119	1,350	67,223	131,012	278,310	148,042	130,269	8	143,607	83 cts.		
Boston and Providence	1837			29,794	11,707	726	285	114,737	156,238	250,882	193,469	57,413	8				
do do	1838			19,953	16,856	486	411	83,234	120,044	266,114	196,974	68,140	8				
do do	1839			19,467	8,604	474	209	65,491	193,562	313,907	234,237	79,670	8				
do do	1840			16,765	13,281	409	334	78,413	143,127	202,601	134,651	67,949	7				
do do	1841			12,722	24,474	309	597	84,857	122,057	230,821	152,015	78,806	7	107,638	93 cts.	37 1-2	Double in part.
do do	1842	41	1,892,831	135,06	21,082	330	514	78,236	112,824	236,469	163,788	72,686	6	132,229	85 1-3		
Boston and Worcester	1837			20,053	9,185	450	206	65,524	94,762	210,047	123,331	86,716	7 1-2				
do do	1838			15,672	12,521	359	281	42,534	85,572	212,324	112,032	100,292	7 1-2				
do do	1839			25,198	18,035	564	405	83,151	126,384	231,807	122,496	109,311	6				
do do	1840			16,667	40,731	374	830	83,043	140,441	267,547	170,855	96,692	6				
do do	1841			27,584	34,949	620	784	100,514	162,998	310,807	190,097	110,001	7	175,000	93 cts.	42	Double in part.
do do	1842	44½	2,726,102	19,073	41,457	426	903	107,979	168,609	362,293	186,610	175,674	7	241,319	70 "		
Nashua and Lowell	1839			2,273	3,900	156	272	23,663	29,885	55,053	36,647	18,406	6 1-2				
do do	1840			4,736	3,447	332	248	24,763	52,582	82,638	35,794	46,849	7 1-2				

TABLE Continued.

NAME OF ROAD.	Date.	Length.	Expended in cost of road.	Rep'rs of engines and cars.	Rep'rs of road.	Rep'rs en'ge & cars per mile.	Rep'rs of road per mile.	Fuel, oil, saleries and incidental expens's.	Total expenses.	Total receipts.	Income from passengers.	Income from freight and the mail.	Dividends per ann.	Miles run.	Cost per mile run ex. of interest on capital.	Maximum grade.	
Nashua and Lowell	1841			8,263	3,149	589	225	84,553	95,966	132,496	75,732	56,764	8			10	Double track.
do do	1842	14	380,000	7,159	4,339	511	319	32,333	43,825	131,188	66,305	64,883	8	44,040	99½ cts.		
Eastern incomplete	1839			8,563	6,527	214	163	38,048	53,174	125,623	113,068	12,564	5				
do do	1840			12,916	7,909	516	316	64,969	85,793	183,296	164,971	18,326	5				
do do	1841			17,820	31,117	309	520	94,381	154,958	299,574	257,734	41,840	6	191,900	81 "		Single track.
do do	1842	55	2,267,000	14,774	14,786	261	261	89,679	119,039	269,169	237,023	32,145	6	184,127	64 "		
Taunton Branch	1839			3,152	1,397	287	127	36,161	40,711	58,018	40,910	17,108	7				
do do	1840			1,714	2,609	156	237	40,348	44,671	75,477	44,900	30,577	6				"
do do	1841			2,253	1,878	205	170	50,912	55,043	76,925	52,279	24,646	7½	20,816	98 "		
do do	1842	11	250,000.	3,419	3,558	220	323	12,088	38,065	77.170	55,711	21,459	8	21,925	133 "		"
NewBedford and Taunton	1840			1,318	2,565	120	233	9,162	13,020	26,437	23,250	3,186	6	27,039	82 "		
do do	1841			3,654	3,416	325	302	15,215	22,285	52,513	39,469	13,044	6	40,734	57 '		
do do	1842	21	426,122	4,418	3,441	210	164	15,495	23,355	55,775	48,483	12,282	6				
Norwich and Worcester	1840								52,503	116,517	78,900	37,617	6				
do do	1841			7,721	6,332	119	108	64,752	78,805	155,261	102,667	52,594	6			22	"
do do	1842	58½	2,158,562	6,289	10,289	132	161	45,501	62,071	112,347	70,821	41,526					
Western	1840			9,618	6,830	164	117	58,746	75,274	157,358	84,343	79,015		144,881	52 "		"
do	1841			16,979	20,207	145	577	67,619	104,806	182,308	113,841	68,467		160,100	65½ "		"
do	1842	117	5,814,807	37,921	48,989	324	418	179,708	266,619	512,688	266,446	246,242		397,295	67 "	83	"
Albany & W. Stockbridge	1842	38½	1,751,084														"
Berkshire	1842	21	205.000														"
Charleston Branch	1842	6	223,144	143	156	24	26	5,890	6,190	12,714	6,168	6,546	3	11,433	54 "	31	

Notes.—It would appear that the several roads, have generally diminished their expenses proportionate to their receipts, with the exception of the *Boston and Lowell* and the *Boston and Worcester* railroads, both of these roads have taken up parts of the flat rail of 36 lbs., and have substituted a heavy T rail of 56 lbs. The former 20, the latter 12 miles.

The *Boston and Providence* took up 20,329 sleepers and substituted new—the same number will be laid down the next year when the repairs to road it is estimated will not exceed say $12,000 per annum.

The *Lowell and Nashua*, paid $47,744 for the use of the Boston and Lowell railroad,—not included in the above account of expenses of operating the road per mile.

The *Fitchburgh railroad* has just been commenced.

The expense per mile of operating the *Boston and Worcester* railroad, and the *Eastern* railroad, (with an increase of business) has been diminished. The latter carried 468,703 passengers at low fares. A new depot cost $10,081. The total cost of the above thirteen roads to 1 Jan. 1843 is $21,184,123.—The cost of the other roads not enumerated, in Conneticut, Rhode Island, New Hampshire and Maine may safely be estimated, in the absence of returnes at $5 to 6,000,000.

Estimated cost of Railroads in New England $27,000,000.

Examination of the Railroad system.

No. IV.

As suplementary to the subject of Financial difficulties we may notice a topic which should properly have been treated in our last article. We refer to

The high price paid for land on our Railroads generally. This is another of those evils attendant upon the times of speculation, coincident with the construction of most of the Railroads in this country. As a general rule we cannot be far from the truth in saying that the prices paid for land were more than double what would now be gladly received by the same individuals for the same property. The sums then charged for Railroad right of way were however always above the current prices for land and were intended to cover the so called *damages* sustained by proprietors, while at the same time that extravagant compensation for unreal damages, was allowed, no offset was permitted to be made for any advantages or benefit to be derived from the road.

A few notorious instances may be given of absurd charges which were made.

When the land taken by one of our main lines of road was appraised, it was given in evidence by one person that if a certain piece of ground of about 30 acres, of which *one* only was taken by the company, were entirely paid for at current prices, and the 29 acres remaining presented to him as a free gift he would not take it. We believe that suggestion of the Chancellor that this was a proper subject for an indictment for perjury was not acted upon.

It is also well known that individuals in very many cases having purchased lands in prospect of improvement by the Railroad have charged for damages as much money as the land originally cost. It is a fact too that persons have purchased on speculation the land through which a projected Railroad was to pass, with the express object of recovering damages.

After reading these and similar instances we need not be surprised to find that no inconsiderable portion of the original cost of many Railroads was expended upon the land alone.

Having thus briefly and in a general manner examined the most remarkable causes which have individually or together operated disadvantageously upon various works, previous to, and during their construction—we have yet a few words to say upon the

Management of Railroads when completed. This is a very extensive field for investigation and might profitably employ the time of any one devoting himself to the subject. Our design at present is merely to notice a few of the more remarkable errors and difficulties attendant upon Railroad management.

The general principles never to be lost sight of are *The maximum of traffic and the minimum of expense.* No saving is profitable that curtails business, and no expenditure is wise, that does not increase it. Railroad companies are not to be regarded as mere monopolies, enriching themselves at the cost of the community—nor as great philanthrophies impoverishing themselves to benefit the public—but

public accommodation and the profit of the company are alike to be regarded.

When Railroads were first used the accommodation afforded, when compared with other modes of conveyance, was certainly but small. Passengers were obliged to repair to certain determined points, few in number, by means of other conveyances—here stage coaches had the advantage—while steamboats sharing in the same disadvantages afforded on the other hand, great room for travellers and a large number of locomotive comforts. But this was soon understood and remedied and now no one mode of travel combines so many advantages and comforts as are attainable by the Railroad system. Similar observations are applicable to the transportation of goods.

But while all this is attainable it is not always attained, and to point out a few of the short comings is our present object.

Some time since we took occasion to insist upon the necessity of a proper professional superintendance (Vol. VII p. 282.) The machinery and management of a Railroad can only be entrusted with safety to one who thoroughly understands them, and yet unlike all other comparable works, Railroads are often committed to the care of those who really do not understand the tools they use. The only valid objection ever offored to them, has been the expense of obtaining engineers as superintendants. We have shown this to be an error in the article, referred to above, and at the present time professional superintendance can certainly be obtained as cheaply as any other. But granting for a moment that it cost more, it is easy to show that the apparent saving is more than made up in other ways. The whole machinery and the road itself may be gradually going to decay while the comfortable idea of saving money is entertained by the directors and stockholders—a great consumption of power may be daily and hourly taking place—that a little real knowledge would at once detect—in short there are a thousand ways of wasting time, power and money, that none but an engineer could discover—and consequently there are as many opportunities of saving by the exercise of a little professional skill. We believe, however, that our doctrine on this subject is coming daily into more favor—certainly the contrast between roads managed and mismanaged is strikingly evident and the best argument in our side.

The want of a properly organized *police* as it is styled in England is another faithful cause of expense and accident. The great length of road in this country is one cause of the insufficiency of force—but it is not so much the number as the regulation of this force to which we refer. If an accident occurs are the men employed so instructed as to their duties as to be strictly *automatic* that is, does each man in his place know what he is to do—to whom he is to give orders and from whom he is to receive them? Or even are the arrangements and instructions sufficient to prevent accident? We think in many cases a negative answer must be given to both these question. Upon our main lines however great

improvements have been made and are still making—and the great demi-god of our country public opinion has done something, not by pointing out how abuses may be corrected—for that it cannot do (notwithstanding Civil Engineering though it does understand almost every thing) but simply by showing that abuses do exist and leaving it to the good sense of the directors to devise the means of correcting them. The locomotive should be the type for all inferior agents on the Railroad—never leaving the track—always going when started—stopping when checked and ever in full career subject to the power of the brake—or even reversing the motion when required—finally silent when not active. There is but one departure from the analogy they must be civil—get out of the way of others, and not like the locomotive make others get out of their way.

At first high prices were thought to be necessary as a renumeration for the great outlay upon Railroads. This notion is now almost universally discarded, either from the good sense or dearly bought experience of directors. So much improvement in this respect has been made and we have said so much upon the subject of low fares that the subject may be dismissed without further notice, with but one remark. When different classes of cars are maintained the highest class should never be above the means of a large number of travellers, or otherwise an empty car or cars will be the result, and ill will towards the company into the bargain—at the same time all classes should be comfortable, decent and clean. The usages of our country and the good sense of managers will soon bring these things to the proper order.

Punctuality is the cardinal virtue upon Railroads. No expense is extravagant that maintains it, and no line will flourish that does not faithfully observe it.

Finally the comfort and convenience of passengers is to be procured in every possible manner. With them a Railroad defies all competition; without them, every other mode of conveyance will be preferred. The details upon this point are so numerous as to prevent even a notice in a single article. We give below extracts from Lieut. Lecount's Treaties on Railways, which we particularly commend for the spirit in which they are written.

Several of the improvements there suggested have been introduced into this country, others of a similar nature have originated here, but there is room for the more general adoption of such comforts.

We have throughout this subject rather spoken of what ought to be than what has not been. It is sufficient to observe that inattention to these points has been a source of loss to many companies—but as we have already remarked, experience is rapidly suggesting improvement which we hope before long to see carried to an extent which will prove beneficial to the public and profitable to the Railroad Companies.

"Directors of railways out of very large towns, should always bear in mind, that those upon which the public find most accommo-

dation and attention to their wants, will, in the long run, carry away all the pleasure traffic; and there are many things yet requisite in this respect. We may instance the regulations (April 1838) for the London and Birmingham railway, that no person can come into the station to see their friends off by the train. This is positively inhuman, and by what process such an insult to the public can have been allowed to come into operation, we know not. Infancy and age, sickness and imbecility, are alike disregarded; and any one who wishes to see husband or wife, child or friend, to the moment of their departure, has no means of doing so but by taking a ticket to the next station on the line. When a thing is so palpable a monopoly as a railway will in general be, and as that railway in particular is, care should be taken not to show it. On the same railway the charge for dogs is monstrous, namely, ten shillings, which has been exacted even for a lady's lap-dog, carried in a muff. Such regulations as these will drive all those from the railway who are not obliged to travel on absolute business; and with an expenditure of five or six millions, (and another line now in the course of construction will most probably exceed the highest of these sums,) every thing that can be done to procure traffic will be necessary, instead of throwing it away. Dogs are not so often required to be carried, and when they are, should be taken at a reasonable rate, and in proper boxes made for the purpose, not locked up under the seats of the second-class carriages, at the risk of being stifled; and when the owner goes at the same time, no charge whatever should be made.

"If a reasonable time for refreshments cannot be allowed, and if the necessary viands for breakfast and luncheon are not provided at the stations, a refreshment carriage should be fitted up for those who choose to take any, which might very simply be done with a stage in sliding parts to lead to it, or the carriages might be made high enough to walk in, and have a communication from one end to the other of the train, as is done on some of the American railways, the passengers sitting along the sides. This would enable every accommodation to be afforded, including portable water-closets. These American carriages are often 60 feet in length, supported by friction rollers on two four-wheeled trucks, to which they are fixed by central pivots, allowing the wheels to accommodate themselves to the curves; and they are also well warmed with stoves. A smoking carriage might also be fitted up, as this habit has become almost a necessary of life with many people; it should be placed last in the train, except horse boxes and empty private carriages, and no platform should communicate with it, nor any connexion exist with the other carriages."

"What we look to in recommending these accommodations is, the number of persons who would take advantage of them, purely for recreation; and we are convinced that no inconsiderable sum of money would be tured into the cashier's hands at the year's end. Many other conveniences might also be contrived on a similar plan. Carriages might also be reserved entirely for ladies, which would

form no inconsiderable accommodation in many instances; also, for outstations, a first, second, and third-class coach may be made in one carriage. Sick carriages would be another great convenience. These might be fitted up in compartments holding two persons each, that is to say, the invalid and his attendant, with a communication to a compartment containing a portable self-acting water-closet. How many persons under the affliction of severe illness would gladly pay double and triple the usual fares for such accommodations as these, whilst the cost to the railway company would be trifling in the first outlay, and amply repaid again with grateful thanks?

"By the use of the sliding stage along the carriages, and still better, by the before described arrangements in America, all the passengers might be accommodated with access to an apartment containing a portable water-closet, the gentlemen being on the one side and the ladies on the other, and a certain sum being paid for the accommodation, say sixpence, on the fare of each person. No complaint could ever be made of this small charge, and it would amply repay the outlay. Having a means of communication from one carriage to another, is a great desideratum in many respects; and as it is perfectly practicable, it is to be hoped that the march of improvement will not cease till it is obtained. In road travelling, a passenger suddenly taken ill, or from any other cause, has nothing to do but to put his head out of the coach window and make his wants known; the coach can be stopped, and he can receive the necessary assistance. But how different is the case in railway travelling? There, unless he has by accident a seat just under the guard, he might exert his voice in vain, and could by no possibility receive the least help if he was dying; in fact, the more he wanted it, the less able would he be to endeavor to obtain it."

"It may be thought that the number of travelling invalids would be so few as hardly to pay the expense of such carriages as these. Setting aside the want of humanity in such an argument, the public have a right to demand some kind of accommodation in this respect, railways having driven from the roads those long established conveyances in which the passengers could be allowed to stop and administer to the wants of nature when imperative, and replaced them by another system, which, great as are its advantages, is certainly in this instance a deprivation, and liable to be a cause of much bodily suffering. Besides, it is not the number of invalids who are obliged to travel, but the number who would travel, both for business, health, and pleasure, if they could have the means of doing so with safety and convenience. How many would be happy to avail themselves of such a mode of conveyance, at almost any price; whilst for the poorer sort of passengers a cheaper carriage might be constructed, which would answer the desired end at very little more expense than the usual second-class coach."

"As nothing which can minister to the comfort and convenience of the public, ought to be neglected, in the organization of a railway, not only as a payment due from these monopolies to the

community at large, but as the readiest means of their producing a remunerating profit on the enormous outlay which is required for their construction in this country, means should be provided at each terminus where the passengers would be able to obtain every accommodation. In the usual course of things, the termini will generally be at some little distance from the towns, in consequence of the additional expense which would be incurred in the purchase of land, if they were taken to a more central situation. From the continual concourse of people at these termini, new buildings will gradually begin to thicken in that part of the town, and, in a few years, habitations will begin to embrace the railway station on all sides. Inns and shops will be amongst the earliest of these erections; still this will be a work of time, and will little accord with the impulse given to the mind by railway travelling."

"It will therefore be highly advantageous, both to the proprietors of the railways and to the public, if the directors provide for the accommodation of the passengers, simultaneously with the opening of their railway. The expense will be small, and the profit may, with the utmost certainty, be reckoned on as equal to that of any other portion of their property. A building should therefore be erected on a convenient spot, adjacent to the principal stations, which should afford to each class of passengers the means of obtaining refreshments in that manner to which their habits and station in life have accustomed them. Such buildings would admit of considerable architectural display, and, if it should not in any case be thought advisable to include their cost in the general outlay, they may be a separate jointstock speculation, the shares being offered, in the first instance, to the proprietors of the railway shares as was done by the London and Birmingham railway company."

The January number of the Civil Engineer and Architects Journal contains the following letter from a New York correspondent with remarks by the Editor. We give the whole as representing in a fair manner some of the main points at issue between English and American Engineers—and also, as conveying, considering the circumstances, a very handsome compliment to our fellow townsmen Messrs. Stillman & Co.

It does not require any assertion of our own that to convince American Engineers, that the engines of the S. & Co. display more originality and real improvement than the English marine engines which we have had an opportunity of examining in our own waters—for these latter are generally speaking strikingly devoid of any exortifications of the old places.

American Marine Steam Engines.

Sir—A late number of your *Journal* contained some remarks concerning American Marine Steam Engines, which were in a spirit very unlike the usual tone of the English press in descanting upon "Brother Jonathan's" available genius in such matters. Candid, fair, impartial criticism, no matter how close it may chance to "cut," will do much towards removing

those mutual prejudices which unhappily exist to such an extent, that the mere imprint of "American or "English," is oftentimes of itself sufficient to place the merits of any work without the pale of respectful controversy.

This should not be; there is not the least of necessity or of policy in being thus deprived of the benefits of each other's experience; as advantages in some shape or other, most undoubtedly belong to each, and only require to be known in order to be secured. As an illustration, might be adduced the acquaintance already formed through the establishment of your Trans-atlantic Steam Navigation Companies. One or two instances will suffice. In the English marine engine we see a connecting rod 15 feet long, and $10\frac{1}{2}$ inches diameter, subjected to the same direct stress with the connecting rod of the American engine, and which is 24 feet long and 6 inches diameter; two thirds *less in area*, and one third *greater in length*, and yet performing equally well the same labor! By this, we are taught, that while the English engines are certainly at *one extreme*, we are probably at the other. Again; the *Great Western*, if you please, comes over here with decks as "clean" as a "man of war," and returns with the singular notion, that on her quarter deck, can be erected, at a trifling expense, a saloon equal in every respect—and superior in many—to the one below, and making an addition to her accommodations equal to one third of all her cabin room below deck!

Notwithstanding the unequalled degree of perfection to which steam navigation upon our rivers has attained—excepting, of course, the great river of the west—the impression is very prevalent abroad, that in the attempt to compete with the "Lion of the seas," we shall be found wanting—an impression unfortunately, most consistent with a certain illegitimate specimen of "Yankee enterprise," which has recently visited your shores. We think however, that the time is not far distant when, with a ship exceeding in length the ordinary proportion, with engines having greater length of stroke so as to admit of working steam at a greater pressure without adding weight to the working parts, with paddle wheels large in diameter, very narrow and making revolutions not less than 20 per minute; and with boilers adapted to a pressure of 15lb., to 20lb., we shall be able somewhat to "shorten the distance" which separates us from the "land of our fathers." Certain it is, that our ship-builders and engineers will not be satisfied with a steamer which will require, for a passage to Liverpool, more than *ten days* of good weather.

You were pleased to notice in a favorable manner the engines of the Spanish steamers *Regent* and *Congress*, built by the late firm of Ward, Stillman & Co., of the Novelty iron works, New York, and to intimate a wish to have the details of their arrangement. In answer to which, I take pleasure in sending to you a detailed account of those vessels, together with so much of a drawing of their engines, as will answer the purpose of your inquiry, and which I am authorized to do by Messrs. Stillman & Co.

Vessels:—	Feet	Inches.
Length on deck	154	0
Breadth	30	8
Ditto at water line	28	8
Depth of hold	14	6
Draft of water	8	6
Burthen	671 tons.	

Frame of white oak, live oak, locust and cedar. The floor of white oak laid close and caulked inside and out. Planked with white oak; fastened

throughout with copper thorough bolts, composition spikes and locust tree-nails.

Engines:—

Diameter of cylinders $42\frac{1}{2}$ inches.

Length of stroke 4 feet 7 inches.

Diameter of paddle wheels 18 feet.

Length of board 7 feet 6 inches, and width 2 feet 6 inches.

Pressure of steam 10lb.

Number of revolutions per minute 26.

Total weight of engines; wheels and boilers 100 tons.

Two copper boilers 22 tons.

Length of boilers 14 feet, height 9 feet, and breadth 8 feet.

Total of fire surface 1400 feet.

Speed of vessel 10 miles per hour.

Cost of vessel, engines and boilers, about 150,000 dollars.

It would be trifling, I fear, with the patience of your readers, to enter into a detailed description of the drawings, representing, as they do—with one or two exceptions—but an "old acquaintance," the "side lever engine;" the principal deviation from which, is the steam valves, and perhaps the air-pump bucket. The valves are shown in the section in the same position as in the drawings you refer to as having received, and which has recently been published in the London *Mechanics' Magazine.* As to the merit of this arrangement of the valves I will not now offer an opinion, except that they are not generally used here for large engines.

As English engineers—either from strict fidelity to the *opinions of Watt* or from much actual *experience*—have held us guilty of divers "barbarisms," in our substitutions for the use of the "slide valve," I shall make this matter the subject of another communication, accompanied with a sketch of the most approved form of the "double" or "balance valve."

The bucket of the air-pump, as shown in the separate sketch, for aught I know, may not be peculiar to this country, nor is it universally adopted here; it has been found, however—in situations where the condensing water is free from sand—to be far more efficient and durable than any other in use.

The "bilge injection," shown near the bottom of the condenser, is here thought to be an essential part of the engine of every steam vessel. And instances have occurred in which the use of it has been attended with the saving of much life and property.

With your permission, I will from time to time furnish your readers with notices—accompanied with drawings—of such improvements in American engineering, as may be thought interesting, or of such of its features as are not familiar to our transatlantic brethren generally.

I am, Sir, &c.,

New York, July 1842. F. W. S.

In our Journal for June last, we noticed that the Spanish government had ordered, and obtained from New York two war steamers, named the "Regent" and "Congress," and in commenting thereon we observed, we wished some further information before we give any opinion on the subject; we were favored with a lithographed external view of the engines, but we desired to look below the surface. Our wish has now been complied with, we are in possession of an apparently perfect section of the engines of the *Regent* and *Congress* steam ships, together with F. W. S's. remarks thereon. and which we now publish. We thank him, and think, if his intentions are supported by engineers of the Old and New World, it

will do much towards the explosion of prejudice, the extension of knowledge, and general good of mankind; that we heartily co-operate in this view we plainly avow, as in fact our remarks in our last December number fully prove. We are, therefore, surprised at the opening paragraph of our correspondent, and we are unconscious of having admitted any thing into our columns which could offend his taste. If we have descanted upon ' Brother Jonathan," it was more in playfulness than anger, not as an opposing race, but as descendants of one common stock, to which *genius* is common. We think, however, our correspondent's reprehensions are misapplied, as we do not recollect using the phrase *he* complains of. With this exordium we at once proceed to an analysis and consideration of the engines of the *Regent* and *Congress*.

The engines are of the *beam* kind, and scarcely to be distinguished from those of the *Megera* by Seaward, published by Weale in his Tredgold, pl. 49, vol. 2. The *architecture* is very similar to the engines of the *Tiger*. by Edward Bury. (See Tredgold, vol. 2, plates 110 and 110 a. In one point they differ, in the use of circular valves instead of the D or Murdock slide, and in this it resembles another emanation of American intellect, calledthe *Royal William* (now *Isabella II.*) which made the voyage to England in 1832, and subsequently figured in the Spanish war.

The cylinders are $42\frac{1}{2}$ inches diameter and 4 ft, 7 in. stroke; at 26 strokes or 238 feet the power is equal to $71\frac{1}{2}$ horses each, or 143 horses collectively. This is nominal power as calculated by the rules of the late Mr. Watt, applicable to steam of $2\frac{1}{2}$ or 3 lb. per inch, but in this case we have a pressure on the safety valve of 10 lb. per square inch, so that the *actual* power will probably be 150 per cent. above this, depending entirely upon the expansion used, and we may further observe, that with a suitable arrangement, circular valves may be made to produce any degree of expansion, at pleasure. The air pump is 22 inches diameter, and about 2 ft. 6 in. stroke, = a content of 6·6 cubic feet. Cylinder $42\frac{1}{2}$ in. + 4 ft. 7 in. long = 49·46 feet content, which divided by 6·6, makes the cylinder 7·5 times larger than the pump, just the usual proportions of English engines. The condenser is 2 ft. 5 in. fore and aft, 3 ft. 5 in. in width, and 4 ft. high, with proper deductions is equal to a content of 24 cubic feet, and 71·5 ÷ 24 = nearly 3 cubic per H. P. The circular steam valves are $11\frac{1}{2}$ in. diameter = 103·86 area, the eduction valves are 10 in. diameter = 78·54 area, or rather more than a square inch per horse, a very ample allowance, and much exceeding Mr. Watt's rules, as will be seen by reference to Farey and other works, but taking into consideration the increased density of the steam employed, is judicious. and about on a par with modern *slide* valve practice. Our correspondent is wrong in supposing that English engineers have adhered to the slide valve "from strict fidelity to the opinions of Watt." It is otherwise; they have departed therefrom and followed Murdock, his disciple, who patented the D, triangular, or other shaped sliding valve, in his specification of 1790 (See Farey, p. 677.) We are at a loss, also, to find any novelty in the construction of the circular valves; they appear to us precisely similar to those used by Mr. Watt* in his engines of 1808. He used circular pipes, and here we have rectangular passages (See Farey, plate 20.) We are equally obtuse respecting the air pump, of which we have an isometrical drawing, and can find nothing new therein; if our correspondent alludes to the packing ring similar to that of the piston, we may say that system has been followed in this coun-

* Or rather his successors Boulton and Watt. Mr. Watt retired from business in 1800.

since the year 1826, perhaps earlier. The bilge injection is in the same category.

There is merit in the adaptation of a double beat expansion valve, though it is by no means new and we think we can suggest an improvement as the lower face can never be tight. The other parts of these engines are so much like the best English practice, that it is needless to pursue the inquiry farther. The space occupied in the vessel for each engine is 16 ft. fore and aft, and about 5 ft. 9 in. over the main beams.

On the whole, we think the engines of the *Regent* and *Congress* to be highly creditable to Messrs. Ward, Stillman & Co. of New York, by whom they were manufactured. not only as evincing considerable judgment in detail, but more so, in their selection of the common beam engine, which, after all, appears to be the best kind yet produced.

Extract from Address

Delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; *by* A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

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What have *we* done to advance the progress of the useful arts? First, what have been the results of our exhibitions? The same which experience all the world over has shown to result from them. But will it be said by any one, however enthusiastic, that the contrast between the meagre show in the Carpenter's Hall, at our first exhibition, in 1824, and the brilliant display which is just now terminated, is due to these exhibitions, or to those in Philadelphia, New York and Boston, combined? Let us reply by another question. Would we, or would we not, have arrived at the same point without these annual or biennial shows? I answer unhesitatingly, No! It has been remarked of exhibitions of specimens in the arts elsewhere, that though the same artists produce the specimens, there is a steady improvement in them. The taste of the public is improved by them—the taste of the artist is elevated. So, here, observe from year to year the growth in taste of the judges of the different articles submitted at the exhibition, and of the depositors, who are the venders of the manufactured articles. What a powerful reaction must be produced by thus furnishing the vender with the means of accurate comparison, the conclusions from which he may communicate to the manufacturer. Observe the public generally, how the admired articles of one year are the rejected of the next! Listen to the remarks made upon those branches of industry which are stationary. To deal with history instead of what is present; turn to the exhibition of two years ago. Take a branch of manufacture then dead, and compare the effect produced by the well preserved mummies of specimens, though carefully washed and well placed for show, with the results of their first living appear-

ance. The glazing and gilding are untouched, the colors of the painting are as bright as ever, the designs just as tasteful as they were when first exhibited; but the taste of the public is improved the specimens are returned to their cases, their interest for the future is purely historical—they are deposited among the archives of the arts. The influence of this improvement in public taste alone is not to be rejected.

It is obvious, then, that there are reasons why exhibitions should contribute to *aid* that which requires other causes to support. If they neither form the foundation of the building, nor yet its superstructure, they serve to determine its shape and the arrangement and distribution of its parts.

The influence of the medals and certificates awarded at these exhibitions is much undervalued by many, who, looking merely at their intrinsic value, consider them as so much silver or paper, They would value in the same way expressions of esteem as so much breath. The great dramatist has sufficiently held such persons up to ridicule by putting their argument touching honor in the mouth of that impersonation of all that is ludicrously contemptible —Falstaff. These testimonials have, however, a value in dollars and cents, which, though *I* cannot precisely estimate it, others may. Those who know enough to be aware of their own ignorance, look to others who have knowledge to guide their opinions. Thus the opinions of the judges, expressed at the exhibitions, become the guides of many and many purchasers, who seek or reject, not according to their own judgments, but according to the decisions of the Institute. Rely upon it, these exhibitions and the premiums awarded at them, have a powerful action upon the consumer, the vender, and the manufacturer, and through them upon the arts.

These periodical exhibitions are times of high excitement in the Franklin Institute. The public is called in, and the members are their entertainers. The fly-wheel of the institution appears to have been thrown out of gear, and the motion is rapidly accelerated. It could not exist under a long continued action of this sort. Why should not provision be made in the ordinary and regular working of the Institution for a constant exhibition? Why should all these products once collected be dispersed, never again to be re-united? Like the Conservatory of Arts, of Paris, or the Trade Institute, of Berlin, we should find such a collection a chronicle of the history of each art in our country. As in the Polytechnic Institute of Vienna, we should find by the side of models and machinery, the raw materials and products of our manufacturers and arts, from the date of their introduction, or use, to the day of exhibition. Were our *Sovereign* prepared to erect the piles of the Conservatory or of the Polytechnic school, we should easily find articles to fill their ample halls,—and is it impossible that this should ever be? Look at the structures raised by the public for education. Who would have believed forty years ago, that such would now exist by the means which have raised them? Voluntary association may do much, but not everything. The desire to accomplish this, among

other purposes, led to the attempt to extend the accommodations of the Institute in 1835. Perhaps under other circumstances we might have succeeded. Had the tide continued to rise, instead of beginning to fall, we might have passed the shoal, and found ourselves in smooth water on the inner side. We may now be satisfied that having ventured much for a great good, we are still safe. This branch of our Institute must bide its time. Meanwhile, the exertions of the Professors and members are forming the nucleus of cabinets of models and products of the arts, which promise to become of value; and the steps taken by the Managers to obtain from depositors specimens of those articles which take premiums or certificates, where the nature of them admits of it, will, if met in the spirit of liberality by the contributors, soon secure a useful and large collection. How interesting a view would have been presented of the progress of American arts, had such specimens been collected at all our Exhibitions! And while on this theme, does not memory call before us one dear to the Institute, as among its earliest friends, its founders, its first Professor of Chemistry, who made the earliest beginning of our cabinet of arts and manufactures, whose zeal and judgment connected him with our best and most useful efforts—though removed from us by death, he lives in our affections, and his name will be perpetuated in the history of our Institution. We already begin to have a history. Already the obelisk is raised, upon the base of which the names of the useful, zealous, and able, among the members of the Franklin Institute are to be inscribed at death—that tablet bears even now the names of Keating and of Ronaldson.

The awarding of premiums for inventions, though distinctly different in part of its operation from similar awards for the best specimen of any art, owes its efficacy to the same principles. It is not the value of the prize, but the value of the opinion, which causes the inventor to submit his designs for examination. This consideration of inventions forms part of the every day business of the Institute. Formerly it was done by the Committee on Inventions, and now by the Committee on Science and the Arts, formed by the voluntary association of the members of the Institute. The time and capital which have been saved to projectors, and to those who furnish them with means, through this Committee, are not the least important of its results. Men who were flattered at home with the idea of being Fultons and Watts, have found that, after all, Fultonism is not so easy of attainment, and those who were prepared to embark their means in schemes, have been saved both money and chagrin. Our countrymen are yet favored, occasionally, with the *novel and astounding* sight of vessels torn to pieces by the destructive agency of gunpowder, fired by the also *novel* method of a wire, heated by means of a distant galvanic battery—and all at the expense of the United States. With the explosion of unexplodable boilers, or of some old fashioned way of preventing this catastrophe. These things merely indicate, perhaps, a plethora in the National Treasury, or, perhaps, that all knowledge is not

given instanter, upon being elected even to high political stations. But, seriously, the award of the Scott's legacy medal and premiums, which our City Councils have delegated to the Franklin Institute, is the source of much usefulness, and, coupled with the opinions given by the practical and scientific men who are united in the Committee of Science and the Arts, has worked good to the arts, their cultivators, and their patrons.

In nearly all the institutions abroad to which I have referred, the publication of a journal in which to record inventions and improvements in the arts, and discoveries in the sciences which bear upon them, is regarded as of high importance. It is obvious, indeed, that this is the only effectual mode of diffusing a knowledge of improvement over a wide space. In days gone by, the mechanic of Continental Europe passed part of his appreticeship in wandering from place to place, to practice his art, as a means of support, and gathering the improvements which might have been made in it, to turn to account on his return home. Now the Journal brings to his door the improvements of the most distant places, with all the rapidity which steam navigation and railroad transit can give. There can be no doubt that of all the means of usefulness of the Franklin Institute, the publication of its monthly Journal is most widely operative. Its readers find a chronicle of the ingenuity of our country in the patents recorded in its pages, while they find the wheat separated to their hand from the chaff, winnowed by the labors of one who brings knowledge unsurpassed in this department to the execution of his work. Copious extracts from foreign journals convey the improvements of Europe to our mechanics and manufacturers, while original articles from our own mechanics, engineers, and men of science, contribute their full quota to the interest and usefulness of the work. It was early determined by the Institute that such a journal must be maintained, and the present periodical, originally commenced by the Professor of Mechanics, was adopted. The expensive nature of the work, its low price and the limited support which it was likely for many years to receive, forbade the idea that it would be a money-making undertaking; and the Institute has been satisfied to support it, as a means of usefulness, at a small annual loss in money. But, for a feature characteristic of the enterprizes of the Franklin Institute, there can be no doubt that this undertaking would have been onerous. Whenever a line of labor likely to benefit the public has been pointed out, and a scheme for rendering it available has been well matured, members have been always found willing to devote their time to its successful execution. It is thus that men engaged in laborious occupations, in which their time and talents are money, have devoted themselves, day after day, to labors enjoyed by the Institution, without looking for any other reward than that of being useful. It is thus that the pages of our Jornal are supplied with materials, original and selected, (some requiring the labor of translation from foreign languages,) by the generous labors of collaborators, whose zeal is tried by the monthly repetition of its exercise.

With all these resources at command, the Institute is still obliged to look to the benefit of this work to the mechanic, as a motive to support its expense, and to wait, in this as in some other enterprises, the time when a greater intelligence in our country at large and increasing resources, will fully repay the pecuniary outlay annually made.

One branch of the labors of the members of the Franklin Institute has, I believe, no precedent in any similar institution—I mean that of original investigation and research. The Institution thus aids to advance as well as to diffuse knowledge. Of the experiments of the Committee on Water Power, one of the highest living authorities (Mr. Rennie) has spoken in terms of the highest praise. The results of the experiments on the explosion of steam boilers have contributed strongly to turn attention away from imaginary sources of danger, and to fix them upon real ones. The conclusions from some of the more refined and difficult experiments, are quoted in quarters which cannot be suspected of either local or national partiality. These various researches, together with those on the strength of materials, must ever remain a monument of the industry and zeal of the early members of the Franklin Institute. They furnish a claim to public favor and support that no similar institution can justly put forth.

From these extended schemes, in which the members of the Franklin Institute are only incidentally partakers with the public in the common good effected by their instrumentality, let us turn our attention to the special means of promoting the mechanic arts, through the intellectual cultivation of those who pursue them. In the infancy of science, every experiment led to a discovery, and the art offered a scarcely less fertile field than science to their cultivators. Now discoveries in science and improvement in art, are the result of well directed trains of observation, experiment and thought. To direct these, the arts call in the aid of theoretical science. Besides the general cultivation of mind to be derived from pursuing any branch of knowledge, in the sciences of mechanics and chemistry are to be found those principles which alone are safe guides to improvement. It will, perhaps, hardly be believed, but it is, nevertheless, true, that not ten years since there lived in our city an ingenious man, who wasted his time and substance, and the resources of his family, in a pursuit after the perpetual motion. How many such disastrous results are prevented from year to year, by the application of principles taught in the lecture room, may be inferred from the number which require the additional nipping action of the Committee on Science and the Arts. Besides, the lectures upon mechanics and chemistry, which constitute the frame-work of our system, the filling up of architecture, mineralogy and mining, has been supplied by the voluntary contributions of members distinguished for their knowledge, and for their powers of communicating it; and even kindred branches of natural history have been, from time to time, furnished from similar sources.

It has always been the liberal policy of the Franklin Institute,

while retaining the control of the institution where, from its nature, the control should be retained—in the hands of mechanics—to call in the talents of other professions to their aid. While by the constitution, two-thirds of the Board of Managers must be manufacturers or mechanics, every citizen is free to become a member. No co-operation is spurned; and in return, knowledge, time, and talent, of various kinds, are at the disposal of the foster mother. This same liberal principle of action shows itself in the very moderate requital expected for all the privileges bestowed, by which membership in the Franklin Institute is placed within the means furnished by the deposit of one cent for each of the working days of the year. Exclusiveness is absent from each and every department of the Institute, and to a degree which, to those who believe such establishments are raised and must be used for the benefit of certain cliques, and the propagation of certain individual influences is almost startling. What would be thought of raising a voluntary committee of the members of an institution, the annual contribution to which of three dollars makes a member, to consider important inventions and improvements in the arts. Such a thing, the advocates of cliques would say, must lead to confusion. A voluntary committee is wholly uncontrolable—and so it should be. Just such a committee—just so uncontrolable—has existed and flourished in the Franklin Institute for several years, every member being at liberty to join it who is willing to perform the labor required of him. I do not think I overrate the importance of this association of members, when I place it next to the lectures. The library and reading room are no doubt more extensively useful to the members; but the knowledge acquired from books and experience, which is called into action in such various ways, and on so many occasions, in the Committee on Science, and the opportunities for intellectual culture afforded by calm investigation, by cool, but earnest, discussion, and by the appeal to experiment, are so practically improving as to rank above all passive means of cultivation.

Besides the Lectures, the Library, and the Committee on Science the Monthly Conversation Meetings serve as rallying points—as opportunities of giving instruction or of being instructed in the scientific or mechanical novelties of the day. In a large metropolis like London, it is always possible, during at least a part of the year, to obtain materials for even weekly meetings of this sort. At the Royal Institution of London, there is an informal lecture at least once a week, corresponding somewhat to our Conversation Meeting. If we could concentrate here the novelties which in our country find vent through various channels, we should be able to carry on these meetings with more spirit than is now done. In the meantime, they are often both agreeable and useful, and, doubtless, will be kept up with occasional intervals.

While thus providing for the improvement of its members, the Franklin Institute has not forgotten their families, their wives and daughters, as well as their sons, wards, and apprentices. When the lectures of the Franklin Institute first commenced, ladies were not

in the habit of attending lectures—in other words, custom most ungallantly excluded them from opportunities of intellectual amusement and advantage. The Institute has turned custom out of the doors, and taken the ladies within them.

A series of schools for youth at one time entered into the plan of the institution. Of these, the drawing school alone is still kept up with an efficiency and advantage which command patronage. I have very little doubt that had not public education taken the new position it now occupies in our city, these designs of the Institute would have been extended. The sovereign has now awaked to the advantages of supporting public schools by public means, although not yet fully prepared to push the principles upon which they are based to their utmost limits.

Among all these means of usefulness, there is no School of Commerce and the Arts like the Polytechnic Institution of Vienna, no School of Arts and Trades like the Berlin Institute, no School of Arts and Manufactures like the Paris Institution. The establishment of a School of Arts has been a favorite project with the Franklin Institute, but thus far has scarcely passed beyond a project; at one time on the point of receiving aid from the Commonwealth, at another almost put in operation by individual enterprize. This object requires means, and these we have not at our disposal. Will public opinion ever so far ripen as to furnish these means? This is an interesting inquiry. I have heard it remarked by more than one person conversant with the minutiæ of the institutions of Philadelphia, that all the enterprizes for the diffusion of knowledge are supported by a small portion of our population; and yet they are intended for the ultimate good of *all*, and should be supported by the *whole community*. There was no doubt a time when the idea of paying for the support of a fire department would have seemed preposterous, and now we quietly pay for insuring our houses, and then in addition, a portion of our taxes goes to furnish the means and appliances for extinguishing fires. What would we think now of supporting a fire department entirely by voluntary contributions? So public opinion oscillates from one side to another. What is at one time impossible, at another is firmly established as the general usage. Where shall we draw the line between that which is to be supported by general assessment, and that by particular contribution? *Shall the principle be that, what is for the good of the whole, shall be supported by the whole?*

It has been long established that the poor must be instructed at the public expense. It is found *cheaper* to educate the masses than to pay for the fruits of ignorance. Besides which, christian charity cares for the souls as well as the bodies of men. But the scheme of public education, free to all, is, even now, and in our own country, very imperfectly understood. Indeed it may be doubted if the public are yet prepared fully to follow it to its consequences. We began, in this country, after the example of the old world, to endow institutions for higher education, universities and colleges. Then we found that this was beginning to build the house at the top. We

turned and established schools, common schools, and occasionally a high school. And now the foundation and superstructure have no connexion. Is not this all wrong?

If we want precedent for a different state of things from the old world, we can find it, and so be borne out by experience, as far as institutions trammelled by feudalism can be guides to us. The so-called University of France includes all public institution within its organization; the highest and lowest are free; why not the middle? why not all?

But it may be said we agree that that which shall benefit all shall be supported by all. We agree that education shall be put upon a *truly republican* basis, that all the schools, from the lowest to the highest, shall be supported from the public purse, that a wider range shall be taken than now in education, and yet the whole shall be supported by the public. But you go further, you ask that institutions for the benefit of certain classes, by name merchants, manufacturers and mechanics, shall be supported or subsidized from the public purse. These classes certainly, in my view, make up no small or unimportant portion of our community. They are surely not so few in numbers, nor so insignificant in influence, that their interests may be overlooked.

But I would go beyond this, and include in one wide system all the institutions of every name for the promotion of knowledge. It is not necessary to weigh their relative usefulness. It would be easy to bring up an array which would include all classes of our community. The Mercantile Library has its objects, the Apprentices' Library others; the Philadelphia Library, the Athenæum, the Philosophical Society, the Academy of Natural Sciences, the Philadelphia Museum, the Athenian Institute, and many similar associations each and all have their spheres of usefulness. Take them together do not their objects include in their range the interests of every citizen of Philadelphia? Are they not intended for the benefit of classes which include all? Would not good done to all of them be done to the whole community? If not, let others occupy the vacant ground. Nor would the difficulty of adjusting claims be an insuperable one. For such it never has been in any country where such a plan has been in fact executed, and executed it has been in many, though not perhaps systematised. What, for example, is the support of the Polytechnic School of Vienna, and of its Conservatory, from the public purse, but part of such a scheme? and just such a part as the subsidizing of the Franklin Institute, under its present organization and management, would be. What the establishment of a Museum of Natural History and of Coins and Antiquities, but the support of the Academy of Natural Sciences and the Museum? What the support of a Royal Library but that of the Philadelphia Library? All of these, or nearly all, every where are under different boards of administration. The scheme is not so Utopian as, at first sight, it might appear. Our schools, colleges, universities, insitutes, museums, academies, associations, under whatever name, for the diffusion and advancement of knowledge, constitute an as-

semblage of objects, embracing within its scope all classes and all interests. Let me commend to your thoughts the idea of forming *a system* from these various parts, not centralized, but like our own political union, each independent, while all are united, *a great system of public instruction, worthy the patronage and support of a free and enlightened people.*

If public opinion were once right in regard to it, the details of the plan would present no serious obstacles. I have just read that a munificent Englishman has left nearly half a million of dollars to two institutions connected with the University of Oxford. Perhaps liberal individuals among us may one day turn their attention to the beginning of some scheme of general secular instruction, required imperiously in aid of moral and religious culture, by the nature of our political institutions. Without intelligence, virtue is comparatively powerless; without virtue and intelligence, liberty degenerates into licentiousness, independence into brutality. Liberty and independence exist but in name. When virtue, liberty and independence fail, the commonwealth which has chosen them as her watchwords, and has emblazoned them with the emblems of agriculture, commerce and the arts upon her arms, will cease to have a being.

Notice of Experiments regarding the Visibility of Lights in Rapid Motion, made with a view to the Improvement of Lighthouses; and of some peculiarities in the impressions made by them on the Eye. By ALAN STEVENSON, *LL. B., F. R. S. E., Civil Engineer.*

In experimenting on this subject, I used the apparatus formerly employed by Captain Hall. It consisted of an octagonal frame, which carried eight of the disks that compose the central part of Fresnel's compound lens, and was susceptible of being revolved slowly or quickly, at pleasure, by means of a crank handle and some intermediate gearing. The experiments were nearly identical with those made by Captain Hall, who contrasted the effect of a single lens at rest, or moving very slowly, with that produced by the eight lenses, revolving with such velocity as to cause an apparently continuous impression on the eye. To this experiment I added that of comparing the beam thrown out by the central portion of a cylindric refractor, such as is used at the fixed light of the Isle of May, with the continuous impression obtained by the rapid revolution of the lenses. Captain Hall made all his comparisons at the short distance of one hundred yards, and in order to obtain some measure of the intensity, he viewed the lights through plates of colored glass until the luminous disks became invisible to the eye. I repeated these experiments at Gullan, under similar circumstances, but with very different results. I shall not, however, enter upon the discussion of these differences at present, although they are susceptible of explanation, and are corroborative of the conclusions at which I have arrived, by comparing the lights at a distance of

fourteen miles, but shall proceed to detail the more important results which were obtained by the distant view. Several members of the Royal Society witnessed the results of the experiments, which I shall briefly describe in the following order:

1. The flash of the lens revolving slowly was very much larger than that of the rapidly revolving series; and this decreasing of size in the luminous object presented to the eye, became more marked as the rate of revolution was accelerated, so that at the velocity of eight or ten flashes in a second, the naked eye could hardly detect it, and only a few of the observers saw it: while the steady light from the refractory was distinctly visible.

2. There was also a marked falling off in the brilliancy of the rapid flashes as compared with that of the slow ones; but this effect was by no means so striking as the decrease of volume.

3. Continuity of impression was not attained at the rate of five flashes in a second, but each flash appeared to be distinctly separated by an interval of darkness; and even when the nearest approach to continuity was made, by the recurrence of eight or ten flashes in a second, the light still presented a twinkling appearance, which was well contrasted with the steady and unchanging effect of the cylindric refractor.

4. The light of the cylindric refractor was, as already stated, steady and unchanging, and of much larger volume than the rapidly revolving flashes. It did not, however, appear so brilliant as the flashes of the quickly revolving lenses, more especially at the lower rate of five flashes in a second.

5. When viewed through a telescope, the difference of volume between the light of the cylindric refractor and that produced by the lenses at their greatest velocity, was very striking. The former presented a large diffuse object of inferior brilliancy, while the latter exhibited a sharp pin point of brilliant light.

Upon a careful consideration of these facts, it appears warrantable to draw the following general conclusion:

1. That our expectations as to the effects of light, when distributed according to the law of its natural horizontal divergence, are supported by observed facts as to the visibility of such lights, contrasted with those whose continuity of effect is produced by collecting the whole light into bright pencils, and causing them to revolve with great velocity.

2. It appears that this deficiency of visibility seems to be chiefly due to a want of volume in the luminous object, and also, although in a less degree, to a loss of intensity; both of which defects appear to increase in proportion as the motion of the luminous object is accelerated.

3. That this deficiency of volume is the most remarkable optical phenomenon connected with the rapid motion of luminous bodies, and that it appears to be directly proportional to the velocity of their passage over the eye.

4. That there is reason to suspect that the visibility of distant lights depends on the volume of the impression, in a greater degree than has, perhaps, been generally imagined.

5. That as the size and intensity of the radiants causing these various impressions to a distant observer, are the same, the volume of the light, and, consequently, *cœteris paribus*, its visibility is within certain limits, proportionate to the time during which the object is present to the eye.

Such appear to be the general conclusions which these experiments warrant us in drawing: and the practical result, in so far as lighthouses are concerned, seems sufficient to discourage us from attempting to improve the visibility of fixed lights in the manner proposed by Captain Hall, even supposing the practical difficulties connected with the great centrifugal force generated by the rapid revolution of the lenses, to be less than they really are.

I shall be excused, I hope, for saying a few words in conclusion regarding the decrease in the volume of the luminous object, caused by the rapid motion of the lights. This effect is interesting, from the apparent connexion with the curious phenomenon of irradiation. When luminous bodies, such as the lights of distant lamps, are seen by night, they appear much larger than they would do by day; and this effect is said to be produced by irradiation. M. Plateau, in his elaborate essay on this subject, after a careful examination of all the theories of irradiation, states it to be his opinion that the most probable mode of accounting for the various observed phenomena of irradiation, is to suppose that, in the case of a night view, the excitement caused by light is propagated over the retina beyond the limits of the day image of the object, owing to the increased stimulus produced by the contrast of light and darkness; and he also lays it down as a law, confirmed by numerous experiments, that irradiation increases with the duration of the observation. It appears, therefore, not unreasonable to conjecture, that the deficiency of volume observed during the rapid revolution of the lenses, may have been caused by the light being present to the eye so short a time the retina was not stimulated in a degree sufficient to produce the amount of irradiation required for causing a large visual object. When, indeed, the statement of M. Plateau, that irradiation is proportional to the duration of the observation, is taken, in connexion with the observed fact that the volume of the light decreased as the motion of the lenses was accelerated, it seems almost impossible to avoid connecting together the two phenomena, as cause and effect.—*Edinb. New Philos. Jour.*

Wire Rope.—Mr. A. Smith has read a paper before the Society of Arts, on the manufacture of wire rope for standing rigging etc. The results of experiments made by order of the admiralty, are that standing rigging of wire rope of equal strength with the hempen rope, one third of the size and half the weight, may be fitted at about two thirds the cost. Mr. Smith stated that "the standing rigging now fitted in her majesty's Navy presents a surface of upwards of 600,000 square feet, which is about equal to the surface of the sails of twenty four first class frigates," that "one fathom of hempen rope

about three inches in circumference will absorb half a pound of water and will contract one inch in length. The standing and running rigging of a first rate, measures about 30,000 fathoms and will consequently when wet, contract in length on an average about 833 yards, or nearly half a mile, and absorb about seven tons weight of water, which being principally carried aloft will materially effect her sailing."

Mr. Norris' Miniature Locomotive for the King of France.—Our readers have seen the notice of a beautiful working model of a locomotive made by Mr. Norris for the King of France. The following notice of its performance will prove interesting to the friends of American industry.

The *Journal des Chemins de Fer* gives the following interesting particulars of some experiments to which the model has been lately subjected:—"His Majesty ordered a small railway to be constructed in one of the galleries near the Marine Museum in the Louvre. This construction was about 90 metres long and 36 centimetres wide, presenting all the inequalities of surface that might be met with in a real railroad. The curves were of the smallest radius possible to be used, and such as will never be met with in actual travelling. Repeated trials of the locomotive were made, under the direction of the maker, in presence of his Majesty, surrounded by his family, several ministers, and a number of officers belonging to his household. The little locomotive drew without difficulty a carriage, in which was seated ten persons of his Majesty's suite, amongst whom was General Gourgand, and this was repeated several times with the most perfect success. His Majesty was pleased to express to Mr. Norris the great satisfaction he felt at the success of these interesting experiments, proving as they did that railroads may now be constructed in every description of locality, no natural ground presenting such difficulties as were designedly brought together on this occasion.

Carpets.—The new mill which is in progress of building in this city by the Lowell corporation, is intended for the introduction of new carpet power looms, which is a new invention by a young gentleman of this city. Heretofore, the hand loom alone has been used. By this new invention, one female will be able to do the work of three men. A few of these looms have been in operation for several months, and their complete success placed beyond a doubt.—*Lowell Cour.*

Automaton.—A machinist of a little town in Bohemia, has constructed an automaton, which imitates perfectly the human voice; sings several difficult airs with the greatest accuracy and executes shakes, runs and the chromatic scales with surprising precision. It also pronounces several words in singing.

Professorship of Civil Engineering.—Trinity College Dublin has established a chair and Mr. John Macneill has been appointed.

Wire Bridge.—In our last we gave extracts from a paper read by Mr. A. Smith before the Society of Arts. The following notice refers to the several communications of Mr. S. before the society.

A wire bridge, of 33 feet span, was erected in the room, the construction of which Mr. Smith explained. The wire rope, forming its principal support, weighed 56 lbs.; the angle-irons, 112 lbs.; and the other parts, including the braces, 56 lbs.; and 112 lbs. for the platform or footpath composed of boards—thus making the whole weight only three cwt., and which might be completed by four men, in about three days, at a cost not exceeding 15*l.*, and could, at any time, be taken down or put up in half an hour. These descriptions of bridges were described as very useful for military purposes, and for throwing over deep cuttings in railways etc., Mr. Smith stated, that for general practical purposes the cost might be taken at 1*l.* per foot run, with a breadth of three feet. Two smaller models of bridges, on different principles of construction, were also shown.

Burning Lens worked by the Drummond or Oxy-Hydrogen Light.—A colossal burning lens, three feet in diameter, and weighing 5 cwt., has been erected in the Royal Adelaide Gallery, intended to be worked by the Drummond, or oxy-hydrogen light. Some private experiments of this power of the Drummond light have taken place, when it was found that the bulb of a differential thermometer introduced into the focus, at a distance of 16 ft., was sensibly affected, and a piece of phosphorus introduced in the same point was fused. It has long been asserted that the heat accompanying light obtained by artificial means does not produce heat capable of being transmitted and concentrated through lenses; these experiments fully prove the contrary.

The *tailors* are threatened with the loss of trade, and the thimble and goose to be superseded by the shuttle and loom. Messrs. G. Martin & Co. having introduced into Philadelphia the English invention for weaving coats and pantaloons, and one of the papers speaks of one of their articles as being as comfortable an article of the kind as one could desire for common wear. Drawers and shirts have been woven in that city for some months.

Type Setting Machine.—An instrument invented by M. Gaubert for the purpose of composing and distributing type, has been presented to the Paris Academy of Science, for examination. The Committee in their report give credit to the genius and labor, but carefully abstain from any observation upon its economical use.

The King of France has presented *William Norris, Esq.* our celebrated Locomotive engine manufacturer, a gold medal, and a gold box ornamented with diamonds, besides giving him an order for the construction of several locomotives.

Timber Tank.—A wrought iron cylinder, 51 feet long and 6 feet diameter, has been erected in Portsmouth Dock Yard, for the purpose of "Burnettizing" timber under pressure. It is composed of plates half an inch thick, and double riveted, and the ends are of cast iron, with doors 2 feet 6 inches square, for the admission of logs. It is fitted with two air pumps of 14 inches diameter, for extracting the air, and two force pumps for increasing the pressure when filled with the solution. On a trial lately made before the Admiralty engineer Mr. Kingston, the cylinder having been charged with 20 loads of timber, the air pumps which are arranged to be driven by Lord Dundonald's rotary engine, were set to work, and a vacuum of 26½ inches was obtained in 30 minutes. A cock in the connecting pipe was then opened, and the solution rushed into the vacuum from the cistern. When the cylinder was filled with solution, the force pumps were set to work, and the pressure was raised to 200 lb. on the square inch. Under this pressure there was not the slightest leakage from any part of the cylinder, nor from the doors. The timber was removed on the following day, and a log was cut up, when it was found that the solution had penetrated to the very centre, and completely saturated it. The pressure at which the apparatus is in future to be worked, is 100 lbs. on the square inch, as this is found to be sufficient for the due saturation of the timber within 24 hours, under the process of previous exhaustion of the air. The whole of the work was executed by Messrs. W. Fairbairn and Co., of London, and the cylinder riveted machine, to which its great tightness may be attributed.

Comparative cost of English and Foreign Railroads.—In Mr. Robert Stephenson's elaborate and important report, addressed to the directors of the South Eastern Railway, on the system of railways, as now projected by the French government, he gives an analysis of the cost of railways in England, selecting three lines—the Northern and Eastern, the York and North Midland, and the Birmingham and Derby—as cases similar in their results to those in France now under consideration; from this, and also an analysis of the cost both of the Belgian and French lines, it appears the average cost per mile of the English lines is 25,450*l.*, the French lines, 23,000*l.*, and the Belgian lines, 16,206*l.*; thus showing a difference in the cost in favor of the Belgian lines over the English of no less a sum than 9,244*l.* per mile, and over the French of 6,794*l.*

Barker's Mill applied to Steam Navigation.—Mr. Less delivered a lecture on steam navigation, with a particular reference to the exposition of a principle proposed to be applied by Mr. Ruthven of this city, and for which he has taken out a patent. The lecturer gave a succinct statement of the history and progress of steam navigation, and remarked that the great obstacle to its extension was the imperfect nature of the paddle wheels. It was to obviate this imperfection that Mr. Ruthven had turned his attention, and his plan was sufficiently simple. It was to apply to the propulsion of

the vessel the principle which was known as that adopted in "Barker's Mill." It consists of a tube, horizontal or upright, into the extremity of which another tube, crossing it at right angles, was fitted, and open at both ends. When water was introduced into the first tube, it naturally made its escape at the two ends of the angular tube, but in its escape it caused this tube to revolve; the water, as it escaped, sending the tube forward in an opposite direction to that by which it escaped, and this with a force proportioned to the pressure of the water. The principle, in fact, is precisely the same as that which causes the recoil in a gun when it is discharged. It had been attempted to be applied to steam navigation before, but had always failed, because, in the lecturer's estimation, the water was always discharged below the surface, which impeded its power of action. He illustrated this by experiments, which certainly showed that the discharge of the water, below the surface of other water was not nearly so efficient as when it was discharged into the air. The mode of its application to the propulsion of vessels, was as we understood, by making apertures in the bows of the ship, through which the sea water would flow into pipes, and thus would be conducted to the place where the steam-engine was situated. There the water would escape by a large pipe running across the vessel and open at both ends, but with the apertures directed towards the stern, which upon the principle referred to, would have the effect of sending the vessel forward. If it was wished to back the vessel the aparatus could be turned in the contrary direction; and if to stop her, they had only to be turned directly down towards the bottom, while the engine never ceased working. In this case, we understand, the use of the engine would be to discharge the water out at the two apertures with a high degree of pressure as the speed of the vessel would be in proportion to the rush of the water. A small model was exhibited without a steam-engine, which showed the soundness of the principle, by the small skiff sailing, backing, and even turning, in water. The lecturer considered that vessels propelled in this way would have more velocity than those propelled by the paddle, besides the great advantage of dispensing with that imperfect implement.—*Edinburgh Courant.*

The Numeral Figures.—The types from which numerals are printed were, from the invention of printing till about 1785, formed so as to give heads, and tails to the figures, in the manner which is always used in handwriting. At the period just named, Dr. Hutton introduced in his logarithmic tables what was then a new form, in which the figures were all of one size, having no parts above or below the others. This system of Dr. Hutton's gradually became universal, much to the regret of all who had to consult mathematical tables, who were glad to use French tables, in preference to English, on account of the surperiority of heads and tails. In the mean time, it was found that with figures all of a size, a larger type was necessary, to secure sufficient legibility, and this type gave facilities to that formation of thick and thin lines which distinguishes

the larger numerals of the existing English press from those of all other ages and countries:

1234567890

It was generally admitted that both circumstances,—the sameness of size, and the swelling of the lines which compose the figures, were unfavorable to legibility; but no steps were taken to restore the old type until lately, when some works were published in what was called the *French brevier*, being a type in which the heads and tails exist, and in which the thickness is as nearly as possible the same throughout. The Council of the Royal Astronomical Society and the superintendent of the Nautical Almanac, have recently come to the determination to restore the old form of the numerals in their respective publications, an example which is pretty sure to be followed in mathematical publications, and perhaps in others.

Deleterious Gas Detector.—An invention is described in the French papers which will, it is said, give such timely notice of the presence of deleterious gas in mines, or other places, as will enable persons to take the necessary precautions to guard against explosions. An explosion from the admixture of carburetted hydrogen with atmospheric air can only take place when the former exists in a certain and know proportion. When the quantity has reached or exceeded this point, the contact of a light instantly causes an explosion. The instrument recently invented has a sort of tell-tale to show the existence of danger, is simple, ingenious, and effectual. Connected with a chemical solution is a kind of float, nicely graduated, and attached to a counterpoise. The solution is of such a nature that it undergoes a change when acted upon by the admixture of carburetted hydrogen, and when saturated to a certain point the float changes its position, and acting in its turn upon the counterpoise, a spring is let loose, and strikes upon a bell or drum, giving out a loud sound, and thus indicating the presence of danger. This ingenious test is not liable to derangement, and the whole apparatus is comprised with a small compass, and of little cost. The solution can be varied so as to be adapted to every kind of deleterious gas.

Architectural Remains in Asia.—The *Commerce* states, that "most favorable news had been received from M. Tessier, appointed to direct the expedition sent to Magnesia, in Asia Minor, in order to raise the remains of the temple of Diana Leucophica. It appears that many more objects had been discovered than was originally expected, amongst others several columns in complete preservation, with their capitals sculptured with extreme delicacy, besides 12 bas-reliefs admirably executed, and a number of statues. The most friendly aid had been afforded by the French authorities in the Levant, and it is expected that a brilliant harvest is being reaped for the Academy des Beaux Arts at Paris."

Erratum.—On page 34, 16 lines from the top for "exchange" read "*enhanced.*"

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 3, Vol. I. Third Series. | MARCH, 1843. | Whole No. 423. Vol. XVI.

☞ This number contains some articles which may appear out of place—bearing date subsequent to the date of the number. This arises from the circumstance that, when the undersigned took charge of the publication of the Journal, late in April, he found it behind time—and being aware of the effort necessary to overhaul a locomotive under way, he deemed it the better plan to run a "train" in both directions until the work should be "up to time" and a little in advance.

To be able to keep it always in advance, he relies much, very much, upon those whose interests are so closely identified with the improvement, and extension of the railroad system in the United States. We ask from every Engineer the result of his experience; and from every friend of railroads, his co-operation in giving circulation to the Journal. To the present subscribers who have, through good report and through evil report, stood by the work, and sustained it as well by their contributions to its pages as by the prompt payment of their annual subscription, he tenders his hearty thanks. And to those who have, like himself, and the railroad cause, for a few years past, been "off the track," he would say, be of good cheer—our turn is coming next. Let us lift together—sustain the Journal and it shall labor to sustain the cause. To the press, for its kindness, he is truly grateful for the past, and trusts that the Railroad Journal will continue to merit and receive its favorable notice.

D. K. MINOR.

IMPORTANCE OF RAILROADS, ESPECIALLY IN THE UNITED STATES.

We find in the New York American the following article from the Cincinnati Daily Chronicle, in relation to the present condition and future prospects of the United States. Assuming the past as a criterion for the future, we may look forward to a condition of things in this country truly sublime to contemplate. *One hundred* years ago and what were we? what are we now? and *what may not we be*, if we will, *one hundred years hence?* In 1743, there was scarcely a *million* of inhabitants within the territory now claimed by the United States, estimated to contain 2,200,000 square miles. Now, in 1843, there is about 18 millions, and it is safe to estimate that in 1943, there will be over 300 millions, indeed Darby estimates the population of 1940, at 386 millions; but say 300,000,000 of inhabitants within our present territory, reaching from the Atlantic to the Pacific, and from Canada to the Gulf of Mexico, embracing almost every variety of soil, and temperature of climate.

We may travel thousands of miles, in a direct line, without crossing our own boundaries; and over a more fertile soil than can be found elsewhere. We have rivers longer, and larger in the aggregate, and furnishing a better navigation than any other country on the globe. Our lakes would by others be called seas. We have a more intelligent, more enterprising and more prosperous population than can be found under any other government; of

course our *movement* is *onward*—our *progress rapid* and our *destiny* truly *sublime*—who can estimate it?

With such elements of prosperity, we must progress with a rapidity astonishing to calm observers under other influences; indeed astonishing to ourselves; and it becomes us as intelligent citizens to look well to the course which we mark out for ourselves. It is not yet 26 years since the first sod was upturned for the Erie canal. Only a *quarter* of a century, and still it is a great *great grandfather*, with a progeny "too numerous to mention," besides its *illegitimate* offspring, railroads, into whose hands the septre has fallen, and by which we are to progress hereafter at railroad speed, with locomotive power, on a level road, or gently ascending grade, until the different States of the Union are so intimately connected that *disolution* will be *impossible.* The past quarter of a century has been productive of important results. We have accomplished more in that period, in the way of improvement, and increase of facilities for the transaction of business, than was accomplished during a *century* previous. We are now somewhat in the condition of the student who has taken his degree at college—just prepared to begin to learn to *advantage.* We have studied some, practised more, and made some great mistakes, and are now in a better condition to *learn* than at any former period. Necessity requires us to proceed, the march is onward, and if we remain stationary, the *train*, *locomotive*, *tender*, *cars*, and all will pass over us. In other words, we shall fall behind the age. How important then that from this time we proceed on correct principles. Let us reason from the past and present to the future, and when we do resume our works of improvement in earnest, let us commence on the *main* lines and carry them forward gradually, but steadily towards the great points on the Mississippi at St. Louis, which is ultimately to become a large city; and north to the *Canadas* for defence, and the *latteral* roads, diverging to minor, but still important points, will follow as a matter of course.

The progress of population is so wonderful, and the causes of excitement and controversy are such that, with all the efforts of a wise conservative policy, we can hardly expect to maintain peace for a quarter of a century to come. There is a constant tendency among us to controversy. Uneasy spirits, with nothing but life, which is apparantly of little consequence in their own estimation, to loose, and everything to gain, a war with Great Britain is almost inevitable. And, therefore, it is of vast importance that we have main lines of permanent railroad, extending from the principal cities to the *interior*, to the *frontier*, to the *far west*, that troops, provisions, and munitions of war may be transported rapidly from place to place, and thus, by rapid movement, and unexpected blows, accomplish much in little time and with comparatively small means.

The economy in money alone, to say nothing of *health* and *life*, during even a short war like our last, would construct more than a *thousand* miles of railroad, of the first class, in this country, or a line from New York to St. Louis; and such a railroad would be equal, at least in the defence of our

9,500 miles of border line, to a regular army of 20,000 men, as, by it, troops could be collected from *eight* or *ten* States, at any point on its line, or at either extreme, in *three* to *five* days, thus *concentrating* or *distributing* a force wherever needed, which might bid defiance to any power on earth likely to attack us.

But the advantages of railroads, as a means of defence, great as they unquestionably are, are mere trifles in comparison with their benefits as a means of social intercourse and *union* among ourselves. Connect distant points by railroad, no matter how different the habits, manners and views of the people, they will soon become acquainted, and eventually assimulated and neighbors; thus dispelling prejudices and cementing friendships, calculated to perpetuate the institutions under which we have risen from a mere handful, and are *growing to be* the *mightiest* nation on earth. We are destined to become, if we remain *united*, and are *wisely* governed, the most powerful nation on earth, from the fact that we have the largest *fertile* territory in one body, with the greatest natural facilities for navigation in our numerous mighty rivers and lakes, and the most enterprising and intelligent people as a mass. Then how important that our improvements should progress under wise counsels, that we may keep pace with the spirit of the age, and find employment and sustenance for the coming millions predicted in the following article.

GROWTH AND POWER OF THE UNITED STATES.

Since the complete establishment of the American constitutional governments, the future growth and ultimate power of the United States has been a problem both with philosophers and political economists. There are two strongly exciting causes to this species of speculation. The first to discover the effect of the freest institutions mankind had ever adopted on the happiness and prosperity of the people under their influence; and the next to discover the natural growth of the only nation which, since the earliest ages of the world, has been left undisturbed in its natural progress. Half a century has not wholly determined these problems, beyond a contingency; but it has furnished us with some elements of the ultimate result. Those especially, which relate to physical growth and power, may be regarded as leading to certainties of result, beyond any disturbing causes, except that of Divine Providence. This future prospect is important, in considering our relations with other nations, and in determining our national policy. For this cause, we propose to take a birdseye view of the natural capabilities of the United States.

The surface of the United States comprehends a space of about two millions two hundred and fifty thousand square miles, and is about *one-twentieth part of the land surface of the earth.* More than one-half of this surface lies between the 35th and 45th degrees of latitude. It is, therefore, in the very heart of the temperate zone, where nature brings man and fruits to the highest measure of comparative excellence.

The circumference or border line of the United States is about *nine thousand five hundred miles in length.* It may be divided thus:

Boundary, in common with British N. America, about	3,700	miles,
Boundary, in common with Mexico,	2,300	"
Coast of the Pacific,	700	"
Coast of the Gulf of Mexico,	1,000	"
Coast of the Atlantic,	1,800	"
Total,	9.500	"

The territory thus enclosed includes also ***nearly ten thousand miles of lake and river navigation***, of which two-thirds are in the valley of the Mississippi. The great lakes make a chain of about two thousand miles; the Mississippi two thousand more; the Missouri two thousand more; the Ohio nearly one thousand; and hundreds of minor streams from the St. Croix to the Sabine, make up thousands more.

It is important to observe, that this extensive country is admitted by geographers of former nations to have the most various soil, climate and productions of any country upon the globe. The inevitable consequence is, that its capabilities for population and wealth are correspondingly great. No country can surpass it in the capacity for production.

Of the whole two millions two hundred thousand square miles of surface, only about two hundred and fifty-five thousand lie in the Atlantic slope, and two-thirds of the whole lie in the valley of the Mississippi. To estimate rightly the population, which, under the natural and known laws of increase, will arise and be readily maintained on this surface, it is necessary, first, to consider for a moment the *arability and fertility* of the Mississippi basin.

The first fact we observe is, that the rivers of this basin are remarkably long. For example, the main stream of the Mississippi rises near latitude 48 degrees and joins the Gulf of Mexico about 29 degrees—thus running through about 20 degrees of latitude.

The Red river, of Louisiana, is estimated by Mr. Darby at one thousand miles in length. The Ohio, on the eastern side, is also one thousand, ascending to the heads of the Monongahela and Allegheny. The result of this is of vast importance. The rains and melted snows, which occasion the annual floods, fall on distant mountains, and raise those streams to great heights, pouring forth a vast volume of water. In proportion to the length of rivers, and their annual rise, must necessarily be the alluvial lands they feed. This is sufficiently illustrated by the river Nile, whose annual floods, coming from the distant mountains of Africa, occasion the fertility of Egypt.

In connection with this fact, we have nothing of equal consequence; that in this vast region there is very little space occupied by mountains, marshes. or lakes, incapable of production. Almost the whole surface is *arable.* These great facts, taken in connection with its locality in the midst of the temperate zone, determine the conclusion, that this great American basin is capable of producing more grain, and consequently, maintaining more people, than any other equal space on earth. So far as our cultivation has extended, the practical result corresponds with this theory, deduced from geographical facts.

The question of American population has become of great interest to speculators on the future progess and condition of the human family; for heretofore, the United States has populated with a rapidity beyond any conceptions which have been formed from the basis of European statistics. In the various estimates which have been made of the progress of American population, there are two, particularly worthy of notice. One by Darby, in a most excellent work, "View of the United States;" and the other by Professor Tucker, in Hunt's Merchants' Magazine.

Mr. Darby's estimate was made before the census of 1830, and is therefore subject to two tests:

	Estimate.	*Reality.*
1830	14,093,000	12,866,000
1840	10,335,000	17,063,000

But an important fact is to be noticed. The greatest error in Mr. Darby's

estimate was in the number of *slaves*, which according to his estimate would

have been in 1840,	4,114,000
But were in fact,	2,487,000

a difference of estimate equal to more than one-half the whole number of slaves. It is to be observed that this *over estimate* of the growth of the slave population has pervaded the calculations of all writers on the subject. They have never allowed enough for the two great *slave checks*, emancipation and bad condition. Mr. Darby proceeds to make an estimate for each year till 1940, one century from this time. The following are some of the results:

1860	35,167,000
1900	115,000,000
1940	386,000,000

Professor Tucker, in his calculations, published in Hunt's Merchants' Magazine, assumes that the ratio by which our population has increased will not long continue the same, but will gradually diminish as the number of persons increase to the square mile. This is mere matter of speculation; but when the people have become very dense, undoubtedly this is true; but as each new State is as fresh and fruitful as the oldest was, this check will not happen very soon. It is to be observed that the increase from 1830 to 1840 was $32\frac{1}{3}$ per cent., which doubles in little more than twenty-four years. This ratio on the population extant one hundred years ago, will give the present actual result. So that this is the real natural increase of the American population. Professor Tucker's calculations give these results:

1900	80,000,000
1940	200,000,000

Comparing the estimates of Darby and Tucker, and taking the mean it may be considered certain that, without Divine interposition to the contrary, one century will increase the population of the United States to *three hundred millions.*

It may be interesting to know the ultimate *capabilities* of the American territory. Ireland contains eighteen thousand six hundred miles square of surface, and eight millions of persons. Notwithstanding this density of population, Ireland has yet a great deal of waste land. It is certain that the United States can contain as great a proportional population as Ireland. Take the same proportion, and it gives the United States an ultimate capacity of containing *eight hundred millions of people*—more than the entire population of the globe! In a historical point of view, the period may not be long before that prodigious result is reached; for in history, two or three centuries is not a very great portion of time. There is nothing in all this for the people of the United States to make a boast of; but there is much for gratitude, and much for contemplation.

The present generation will never see these astonishing results; but they are doing what will certainly influence widely these advancing millions. We do not believe that political society admits of much reformation in its old age, which was not attempted in its youth, any more than an old man is apt to change the habits of his life. The foundations we wish this vast political society to stand upon, we ought to have not only laid, but most firmly built up at this very time. In vain do we grow, if we grow not wisely. The power which the United States must have to maintain a happy liberty, is an intelligent moral power. They must do right and do right intelligently. The great levers of this power are the school, the press, and the church. The school needs to be more elevated, the press to be purer and better. Can we not attain a higher and a better standard?

AMERICAN RAILROAD IRON.

When on a visit to the *Albany iron and nail works*, under the management of John F. Winslow, Esq., near Troy, a few days since, we were gratified to observe that, notwithstanding the general depression of the business of the country, the proprietors of this establishment were enlarging their works preparatory to a more extensive business.

The manufacture of iron from the *pig* into nearly all its various forms, is carried on in this establishment, and then into *nails*, ship and boat *spikes*, and various other articles. We also discovered in our rambles—which were without a guide or any one to explain the half we saw, to advantage—through this extensive manufactory, that the manufacture of *steel* is carried on to a considerable extent, and we were shown, and now have in our office, a specimen of *files*, the manufacture of which has recently been commenced by Mr. Winslow.

But the information obtained which pleased us most was, that Mr. Winslow is ready to receive orders for the manufacture of *railroad iron*. The introduction of this branch of manufacture will be of immense advantage to this country. We have sent abroad within twelve years, more than thirty millions of dollars for railroad iron alone, which ought to have been paid to our own iron manufacturers. We have the materials of the very best quality, and we have also the *skill*, and the *enterprize*, and the *capital* to work them; but, unfortunately, there has not been given to it the attention necessary to perfect *machinery*, to enable us to compete with foreign cheap labor. It is idle to say we cannot do it. We *can* do it, and *shall* do it. Let those who have already done so much to elevate American character, in the improvement of American machinery, give their attention to the manufacture of railroad iron, as they have to other important subjects, and we shall ere long be able to supply the demand for railroad iron in this country from our own mines. If Mr. Winslow and his associates will give to the subject that attention which its importance demands, and overcome the *imaginary* as well as the real difficulties in the manufacture of railroad iron, they will be entitled to the thanks, the gratitude, and what is far more important, the *patronage* of their countrymen. And we shall be gratified if we can in any way promote their interest in this new effort to promote American manufactures. The *present* is perhaps the most fortunate period possible for them to undertake an enterprize so important. Capital in abundance, price of labor low, everything cheap, and the *energies* of the country rapidly assuming an elasticity which will surely give impetus to the railroad system, and carry out many an important enterprize projected and commenced years ago, but suspended by the *tornado* which swept over the land, and prostrated many a sturdy oak of rapid growth, whose branches had expanded more rapidly than its roots. The time is, however, at hand when many a tree, whose branches have for years been leafless, and whose roots have been upturned and withering under the scorching blasts of a baneful *sirocco*, will again take root and flourish and become, under a more careful culture, the pride of

the forest. We therefore say to the gentlemen of the "Albany iron and nail works," God speed you in your new enterprize. May you be successful, and derive a profit from the enterprize at least equal to the benefits which we hope may result to the country from the example.

STREET SWEEPING MACHINE.

WHITWORTH'S PATENT STREET SWEEPING MACHINE.

We gave, in the June number, a description, accompanied by a wood engraving, of Whitworth's street sweeping machine; which we found in the Civil Engineer and Architects' Journal for April. This machine has been introduced into use in Manchester, and after more than a year's experience in an extensive district, it has been found to answer well, and the commissioners of police recommend its use exclusively in the cleaning of streets in that city.

One of the machines has been sent to this city for trial, and has been used both in this city and Brooklyn, but not having the opportunity of seeing it in operation, we are unable to give an opinion as to its success, but of the entire practicability of the construction of a machine to clean our streets, *far more* thoroughly than it has ever been done, either under the old or the new system, we have not a doubt; and, if the testimonials accompanying the late report of the company using this machine in Manchester and its vicinity, extracts from which we give herewith, are to be relied on, as we doubt not they are, it is well worth the attention of our citizens, whose comfort, as well as interest will be greatly promoted by the use of machines with *wheels* instead of legs and *votes*. If a machine had *votes* in proportion to its superiority over the present mode of operation there would be no trouble in introducing it into use in every *city* and *village* in *this State;* and indeed it would not be singular if a few were sent out into the western wilds where some noble patriot has all the requisites, in his own estimation, except votes, to serve the dear people.

By the mode in use in this city during the past ten years, the loose dirt has been *stired* up, once or twice a week, in *dry* weather, but never disturbed when most troublesome, in *muddy* weather, thrown carelessly into carts, to be driven to the place of deposit, but owing to carelessness or design, no small portion of it is scattered to the four winds, as the carts pass through the streets, to the great annoyance of pedestrians, and housekeepers who are so thoughtless as to raise their windows for fresh air. By the new mode we understand that the work may be done quite as well in wet as in dry weather, and that it is much more thoroughly done than in the ordinary way, without dust in sweeping, and without scattering after it is deposited in the cart; and the expense of sweeping a given number of square yards is not half as much as in the ordinary way. We think the *health*, *convenience*, and *interest* of the citizens will be equally promoted by the introduction of *machine* sweeping in the streets of all our large cities. And, therefore, our efforts will be given to a better understanding of the subject. We give annexed, extracts from the company's last report, with other testimonials from witnesses competent to judge and speak of the merits of the machine.

EXTRACTS FROM THE REPORT OF THE ROAD AND STREET CLEANSING COMPANY.—MANCHESTER, FEBRUARY, 1843.

"The road and street cleansing company has been formed to carry into general operation throughout the united kingdom, the patent sweeping machine, invented by Mr. Joseph Whitworth, of Manchester. More than twelve months have elapsed since the machine was first set to work in that town, and during the greater part of that time it has been used throughout an extensive district, under the immediate direction of the company.

"In March, 1842, a part of the township of Manchester was assigned by the commissioners of police for trial of the machine, and a contract was entered into for working it therein during three months. The district included several principal thorougfares, and contained upwards of 30,000 square yards of street surface. By the terms of the contract, the surface was to be cleaned three times oftener than under the old system, for three-fourths of the cost, or at one-fourth the former rate.

"The district in question soon presented a striking contrast with the other parts of the town, and before the contract expired, a memorial for its renewal and extension, signed by more than one hundred of the principal inhabitants, was presented to the commissioners. The contract was accordingly renewed for twelve months, and the district extended to include 90,000 square yards.

"The late commissioners, in their report for last year, recommend their successors to prepare for the exclusive employment of the machine, throughout the township, after the close of winter.

"It has recently been introduced into the adjoining township of Chorlton-upon-Medlock, the whole of which, containing 171,000 square yards, is now held by the company under contract.

"The working of the machine in these districts, has afforded ample opportunity of testing its capabilities, and furnishing satisfactory data for general calculation. The following are some of the actual results obtained in Manchester.

From the 25th of June, 1842, to the 9th of February, 1843—8,162,000 square yards were swept in the enlarged district, containing 83,000 yards of

paved streets, and 7,000 yards of Macadamized surface. The time occupied, taken on the average, for two machines, was 6½ hours per day for sweeping and loading, and 2½ hours for carting to the depot yards and unloading. This for 188 (the number of working) days, gives an average per machine, of 21,702 yards per day of nine hours. During a considerable portion of the time, only one horse was worked in each machine. Moreover, the period from June to February, includes nearly the whole of winter, when the work is heavier than at any other season. The average amount of work by one machine, with two horses, in the above district, may, therefore, be fairly stated at 24,000 yards per day, or 7,200,000 yards per year, of 300 working days. This quantity is equal to the performance of more than 20 men on the present system, in sweeping alone.

"The quantity of sweeping which each machine can do per day, must of course depend in a great measure, on the provision made for deposit. In the above calculation nearly one-third of the whole time is allowed for transport and unloading, being the average proportion of time so occupied in the company's district. But this is a much larger proportion than would be necessary under a permanent system, embracing an entire town. The depot yards might be so arranged as to prevent any loss of time in transport, and the cleansing power of the machine would be proportionally increased. Where provision cannot be conveniently made in large towns for deposit in yards at proper intervals, the patent machine may be constructed of two parts, viz: an upper, carrying the sweeping apparatus, and a lower, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit.

"The average extent of surface swept by the patent machine for each load of street soil, has been about 4,000 yards. By the report of the police commissioners the average per load for the township of Manchester, in 1841, was 764 yards—a difference of more than 4 to 1, in the state of the same district, now, and at a former period.

"The result affords the most satisfactory and decisive evidence of the beneficial operation of the patent machine. It is also important, in reference to the required provision for deposit, showing that the depot yards may be placed more than two miles apart, while the time now occupied in transport, is saved to the machine.

"Sufficient opportunity has not yet been afforded to ascertain the amount of effect in promoting durability of street structure. But it is observed, that the streets swept by the machine, are dry after rain, long before those in the immediate neighborhood. The water rapidly finds its way to the channel, and has the effect of cleansing the surface of the pavement. The machine itself may be worked on pavement, during rain, with great advantage. The operation of cleansing is more effiiciently performed, and the water, which would lie in the hollows on the surface till evaporated, is at once removed. Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement. The cart when full is drawn to the side of the street, at some distance from a sewer grid, and the pipe-plug being withdrawn, the water flows into the channel.

"By a slight modification of the original form of the machine, it is enabled to sweep close up to the curb-stone, along the side of the street; and the hands before required to clean out the gutters, are dispensed with. The ac-

tion of the brooms is regulated with the greatest ease and nicety, according to the state of the weather, and the nature of the surface, by a series of weights, which counterbalance a certain portion of the weight of the sweeping apparatus, and relieve the pressure of the brooms on the ground. The brooms with the entire apparatus, may also be raised entirely from the ground, by means of a handle turned by the driver, whenever it is necessary to suspend the operation of sweeping, as, when the cart is full, or the surface obstructed. The same handle will raise the sweeping apparatus into the horizontal position, when access is required to the hinder part of the cart, for the purpose of unloading.

"No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface, the round and square set stone, the Macadamized road, and the wood pavement, all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention, and will, no doubt, tend to facilitate the general introduction of that useful invention.

"In Manchester, the average of the present rate varies from 3s. 6d. to 5s. per 1,000 yards. By the aid of the patent machine, it will be generally reduced to about 1s. In most places, however, the greater part of the pecuniary saving will be absorbed in more frequent cleansing, while the advantages resulting to the public will chiefly consist in the improved state of the thoroughfares, and the consequently improved condition of the people.

The following extract from the fourteenth annual report of the lamp, scavenging, etc., committee, Manchester, 1842, shows conclusively that this mode of sweeping is altogether superior to the previous mode.

"In 1838, 13½ millions superficial square yards of streets were swept, from which were carted away 39,409 loads of sweepings; last year, 21½ millions superficial square yards were swept, but only 25,029 loads had to be removed, amply proving, that the system of scavenging in operation during the above period, has effected a highly beneficial change in the cleanliness of the town, tending, not only to the prevention of infectious disease, but to the effecting of a considerable saving in the wear and tear of the pavements. These advantages have been realised still more fully in the district assigned to the 'road and street cleansing company,' under the contract reported to the commissioners, in July last, and if their machine proves as efficient in the winter, as it has up to this time, the committee recommend their successors to purchase or hire a sufficient number for the town, and to work them under the exclusive direction of the commissioners."

"*Street Sweeping Machine.*—We understand that Whitworth's 'patent cleansing machine,' which has been in operation in Manchester for the last ten months, and has given universal satisfaction, is about to be introduced into the Metropolis. Manchester, instead of being the dirtiest, is now, we believe, the cleanest of our large towns. The introduction of the machine here, induced a smart competition betwen it and the old force of sweepers; and, although the latter are unable to maintain that degree of cleanliness in their districts, which is accomplished by the machine in the one allotted to it, the general improvement in the town, over former years, is very striking. The difficulty of cleansing the crowded thoroughfares of London at this season of the year, by the old mode, appears almost insuperable; but we have no doubt, that the introduction of the machine there, will be attended with the same gratifying result we have witnessed here. The power of the machine is extraordinary, being equal to thirty men; and, in its operation,

the numerous annoyances which are inseparable from the old mode, are altogether avoided."

We could give numerous other extracts of a similar character, from foreign journals, but our object being merely to call attention to the subject, these will suffice—and with the following from the Tribune, and a cut representing the machine at work, we leave the subject for the present, with the remark, that if found in practice here, what it is represented to have been in Manchester, it will be put into use, even though the gentlemen of *Orange street*, may not altogether approve of it. We have *yet* to learn, that valuable improvements are to be discarded, or destroyed by a mob of those who have sought an asylnm among us from starvation and nakedness in their own country, simply because it may compel them to seek other employment.

The editor of the Tribune says, "An experiment was made yesterday in Chambers street, between Centre and Broadway, with the new 'street sweeping machine and self-loading cart,' which is of recent English invention, and has been hitherto entirely unknown in this country. The trial was made under the direction of C. J. Buchingham, Esq., the American agent of the patentee, and the machine used was one which he imported. Its operation was very successful, and fully illustrated the principle of the machine, which was all he intended to do, as those he proposes to build in this country will be improved in several essential particulars and be much lighter. A wide track was swept almost perfectly clean, the dirt being deposited in the cart and removed as the process of cleaning went on. No dust was raised, although the street was very dry; and the machine removes mud and stones with almost as much facility as ordinary dirt."

The London Architects' Journal for June says, that "The patent street cleansing machine of which we gave a detailed account in our April number has continued in daily operation in Regent street. All parties express themselves perfectly satisfied with its performance, and anxious to see it generally introduced. A public company is now forming for working the machine in the metropolis and its vicinity."

We shall be gratified to see this machine in successful operation, and to know that those interested are liberally compensated for their enterprize, but we give them warning that they may look out for competition if they are *thought* to be successful, as there is a great propensity in this country to out do other people, so great, indeed, that we not unfrequently out do ourselves.

The last report of Mr. Schlatter on the railroad from Harrisburg to Pittsburg having not yet received a notice in our Journal, we give in the present number several extracts from it. It would be impossible to follow out the details of the various routes without entering into local descriptions too minute and too extended to be of interest to the general reader.

A careful examination of this document has satisfied us of the immense amount of labor required to complete the thorough examination of the various routes. The result at which Mr. S. has arrived—a route remarkably direct between the termini, and at the same time presenting a more favorable grade than any other, when we consider the nature of the surface surveyed —may be esteemed one of the finest achievements of engineering science in our country.

We give the outline description of the preferred route with the cost of that line which adopts the most economical of the many sub routes given.

The report on the Chambersburg and Laughlinstown turnpike contains so much valuable information upon a neglected subject, that we have drawn largely from it.

There is also much that is useful in the principles laid down for the reduction of the routes to a level straight line, and this, together with the estimates of fuel etc., will be found highly interesting to engineers.

MIDDLE, OR PREFERRED ROUTE,

Which commences at the terminus of the Harrisburg and Lancaster railroad, at Harrisburg, and pursues the eastern shore of the Susquehanna river, to a point $4\frac{88}{100}$ miles, above Harrisburg, where it crosses the river, and follows the western bank to the mouth of the Juniata river. Thence, the line is traced along the southern shore of the Juniata to a point two and a half miles below Lewistown, where it crosses the river and canal, and follows the valley of the Kishacoquillas creek to a point five and a half miles above Lewistown, where the creek is crossed. Thence, the line runs in a north-westerly direction, until it strikes the Stone mountain, the slope of which it ascends gradually to a point favorable for piercing the mountain by a tunnel; thence, crossing the head waters of Stone creek, and the dividing ground between Stone and Shaver's creeks, the line descends the valley of Shaver's creek, and continues along the southern slope of Tussy's mountain, until a point on the Little Juniata, five miles above the Juniata division of the Pennsylvania canal at Petersburg, is attained. Thence, following the valley of the Little Juniata to Logan's Narrows, (where the ascent of the Allegheny mountain commences,) the line is traced on the side of the mountain, ascending with gradients varying from a level to forty-five feet per mile, until the summit of the mountain is attained at Sugar Run Gap. From this Gap, the line descends the western slope of the mountain to the Black Lick creek, (near Ebensburg) which it follows to its junction with the Conemaugh, below Blairsville. Crossing the Conemaugh, a very direct course is pursued towards Pittsburg, the line crossing the Loyalhanna about two and a half miles north of New Alexandria, passing near the towns of New Salem and Murrysville, following the Turtle creek to its junction with the Monongahela river, and by this river to Pittsburg. The total distance from Philadelphia to Pittsburg, by the route surveyed last year, and by the Columbia and Harrisburg and Lancaster railroads, was found to be three hundred and forty-eight miles. The surveys of this year have reduced this distance to less than three hundred and thirty-seven miles, making a saving of more than eleven miles, without, in any instance, exceeding the maximum grade of the Philadelphia and Columbia railroad, viz: forty-five feet per mile.

Graduation, masonry, and bridging on two hundred forty miles and thirty-six hundredths, for a *single* track,	$3,973,785
Two hundred forty miles and thirty-six hundredths of superstructure, at $10,000 per mile,	2,403,600
Turnouts and passing places,	72,000
Depot, buildings, water stations, etc.,	60,000
Engineering, superintendence, etc.,	100,000
Right of way and land damages, $500 per mile,	120,180
	$6,729,565
Add 5 per cent, for contingencies,	336,478
	$7,066,043

As the connection of the public works of New York with those of Pennsylvania, by means of the Williamsport and Elmira railroad, and the northern route of the Harrisburg and Pittsburg railroad, is looked upon as being of the greatest importance to the interests of the Commonwealth of Pennsylvania, as the means by which a great amount of trade and travel will eventually be passed through our State to the sea-board at Philadelphia, I have prepared, according to your direction, an estimate of the cost of constructing the connection between the Williamsport an Elmira, and the Harrisburg and Philadelphia railroad.

The distance from a point opposite Williamsport to the railroad at Harrisburg is ninety-one and a half miles.

The graduation, masonry, and bridging for a double track in this distance has been estimated at	$828,996
Single track of railway, ninety-one and a half miles, at $10,000 per mile,	915,000
Land damages, buildings, water stations, turnouts, and double track where necessary,	100,750
	$1,837,646
For engineering and contingencies add ten per cent.,	183,764
	$2,221,410
If the graduation is formed for the reception of a single track, the cost of the connection will be reduced to	$1,785,974
The estimate for completing the Williamsport and Elmira railroad, furnished me by the engineer of the road, is	740,000
Total sum required to connect the New York and Erie railroad, the Buffalo and Boston railroads, and the Erie canal with Philadelphia,	$2,525,974

As the distances between all the points from Dunkirk to New York, and to Philadelphia, have been now ascertained by means of railroad routes, either in operation, partially constructed, or surveyed, it may not be irrelevant here to exhibit the situation of each point of importance upon the routes leading respectively from Dunkirk, on lake Erie, to New York and Philadelphia.

FROM PHILADELPHIA TO DUNKIRK BY CONTINUOUS RAILROAD.

From Broad st., in Philadelphia, to State st., in Harrisburg,	$106\frac{3}{4}$	miles.
From Harrisburg to Williamsport, by northern route of Harrisburg and Pittsburg railroad,	$91\frac{1}{2}$	"
From Williamsport to Elmira, by Williamsport and Elmira railroad,	74	"
From Elmira to Dunkirk, by the New York and Erie railroad,	194	"
Total,	$466\frac{1}{4}$	"

FROM NEW YORK TO DUNKIRK.

From New York to Piermont, by the Hudson river,	22	miles.
From Piermont to Elmira, by the N. York and Erie railroad,	252	"
From Elmira to Dunkirk.	194	"
Total,	468	"

From the foregoing statement, it appears that the distance from Dunkirk to New York is one mile and three-quarters greater than from Dunkirk to Philadelphia. This statement is believed to be correct, as the distances from Dunkirk to Elmira, and from Elmira to Piermont, were taken from the second report of the directors of the New York and Erie railroad, dated February 1st, 1841, and are there stated to be predicated on the *shortest route;*

and the distance from Elmira to Philadelphia has been ascertained with great accuracy since the completion of the survey for the northern route of the Harrisburg and Pittsburg railroad.

I am not prepared, at this time, to enter into a comparison between these routes, as I am not in possession of sufficient information relative to the New York and Erie railroad, but it may be as well here to state, that, on the route from Elmira to New York, the gradients rise as high as sixty feet per mile, while on that between Elmira and Philadelphia, the maximum grade is confined to forty-five feet per mile.

The aggregate of ascents and descents on that portion of the New York and Erie railroad between Elmira and Piermont, on the Hudson river, (22 miles from New York,) is stated in the report before alluded to as being 3,820 feet.

The aggregate ascent and descent from Elmira to Philadelphia, via the Williamsport and Elmira railroad, the northern route of the Harrisburg and Pittsburg railroad from Williamsport, and the Harrisburg and Philadelphia railroads, has been ascertained to be feet.

SECOND REPORT ON THE SURVEY FOR A MACADAMIZED ROAD BETWEEN CHAMBERSBURG AND LAUGHLINSTOWN.

The plan of an artificial highway, or well constructed turnpike, with easy grades, extending through the broken and mountainous regions of the counties of Bedford and Somerset, for the purpose of connecting the Cumberland valley railroad with the contemplated railroad from Laughlinstown to Pittsburg, and thus forming a continuous communication from Philadelphia to Pittsburg, has been recommended for several years by those who advocate the interests of the southern tier of counties in Pennsylvania.

The combined nature of such a system of improvements, it has been alleged by its advocates, would allow of a very important saving of distance, if that part of the route which presents the greatest difficulties to the establishment of easy grades and direct courses, viz.: from Loudon to Laughlinstown, should be traversed by a turnpike.

As the employment of horse power on a turnpike for the transportation of goods may, under some circumstances, be found cheaper than the use of steam power, it was thought that the little expense with which goods could be transported over such a turnpike, added to the small tax which the cost and maintenance of such a road would impose upon the conveyance, would enable the improvement to compete successfully with rival lines. How far these views are correct, it is not for me here to decide; indeed it would appear premature to offer at this time a comparison between continuous lines of railroads which are now in course of construction, or in contemplation, and the improvement before us. It is true that the wagoning which is now carried on upon the southern turnpike, especially during the winter season, when the Pennsylvania canals are closed, will, as soon as the Baltimore and Ohio railroad is extended to Pittsburg, and a continuous communication by railroad established between Philadelphia and Pittsburg, entirely cease with respect to the transportation of goods from the Atlantic to the Ohio, and vice versa. But we should remember that the Cumberland valley railroad is in existance, and will be connected with the Baltimore and Ohio railroad—that this improvement extends through a very rich agricultural district; we should also consider that the growing population of the southern tier of counties will not only *require*, but be able in time to *support* a good turnpike themselves, and that the comparatively little cost of such an improvement will not require a very large business to sustain it, and we will come to the conclusion that this project should be treated differently from the manner in which rail-

roads generally are, and that, at least at present, it cannot be brought into a fair comparison with the other great thoroughfares from the east to the west.

The completion of the Baltimore and Ohio railroad is not very far distant, and the eventual formation of a continuous line of railway from Philadelphia to Pittsburg, by the shortest and best route, is equally certain. After these two lines have been in operation some time, and the Cumberland valley railroad has been extended to the Baltimore and Ohio railroad, we will be enabled to form a just estimate of the prospects of a combined improvement, which is to extend from Chambersburg to Pittsburg, nearly midway between the Baltimore and Ohio railroad on one side, and the Philadelphia and Pittsburg railroad on the other.

Actual surveys have rendered the idea of constructing a railroad through the counties of Bedford and Somerset, in the direction from the east to the west, to say the least, very problematical. The formation of the country appears to forbid such an attempt. The Laurel hill, Allegheny mountain, Ray's hill, Sideling hill, Scrub mountain, Scrub ridge and Cove mountain, form barriers, stretching parallel to each other directly across the course of the line, which appear effectually to prevent the attainment of short and straight distances, and the reduction of the gradients, upon which features the success of a railroad mainly depends. It was therefore but justice, while extensive surveys for a continuous railroad from Harrisburg to Pittsburg were being made, to authorize the survey for an improvement through the southern tier of counties which appeared to be best adapted to the character of that country, and would therefore promise a fair result. This survey has been made, and the distance from Laughlinstown to Loudon, by the line actually surveyed, was found to be ninety-nine miles, which may, by some alterations, and substituting the maximum grade in some places for a level grade, be reduced to ninety-eight miles. The distance by the present turnpike is eighty-seven miles, or eleven miles less. This may appear to some a great increase of distance, and there are many persons who entertain the opinion that a road, with no inclination greater than two and a half degrees, could be located with the same distance as the old turnpike. I am, however, convinced that the line established by the surveys of my principal assistant, Mr. Roebling, (with the exception of some minor alterations,) will be found, by future surveys, to be the best the nature of the ground will admit. Between the mountains we have invariably saved distance, but, in crossing them, we had of course to allow that distance which was necessary to overcome their elevations with grades not exceeding two and a half degrees. If a road should ever be made by the located line, its gentle gradients, (compared with the steep grades of the present turnpike,) would enable stage coaches to traverse the whole distance of Loudon to Laughlinstown, in thirteen hours, with less labor than it is now accomplished within the usual time of twenty-four hours. The greatest difference, however, would be experienced in the transportation of heavy goods. The best six horse teams are capable of hauling, on the present turnpike, when it is in good order, but from sixty to seventy-five cwt., the last being rather an extreme load. When the gradients are reduced to two and a half degrees, and the road kept always in a good state of repair, the same teams may then haul a load of six tons. One ton is the least allowance for one horse on well graded turnpikes in Europe, and the expense of hauling could not be cleared by taking less. It may be proper here to mention the charge of transportation on turnpikes. During the past season, many wagon loads of goods have actually been transported from Baltimore to Pittsburg for the trifling sum of from 75 cts., to $1 25 per cwt. The latter price is considered a fair compensation. One six

horse load was contracted for, to be taken from Baltimore to Zanesville, in Ohio, for $1 75 per cwt., and the wagoner appeared to be satisfied with his price.

No survey was made from Loudon to Chambersburg, as the site for a new and well located road would vary but little from the present turnpike.

Annexed to this report (54) will be found a table exhibiting the results of the estimates of cost for each mile of road, together with the average prices, amount of excavation, length of bridges, etc,

The dimensions of the road and the slopes of the banks, upon which the estimates have been based, vary with the nature of the ground. Where the ground is level, or not much sideling, the whole width of the road bed between the ditches is assumed at thirty-four feet—the side ditches on such locations to be six feet wide on top, and two feet deep. The metalling or stoneway, will be eighteen feet wide, leaving an earth or summer way of eight feet wide on each side, between the stone way and the ditches.

In deep cutting, the width of the road bed between the ditches is reduced to twenty-four feet, leaving a foot-path of three feet on each side of the stone way. The latter preserves its width of eighteen feet throughout. The ditches are in this case assumed as four feet wide on top.

High embankments occur but seldom, and will have a width of twenty-six feet on top, leaving a foot-path four feet wide on each side of the stone way. The slopes of the embankments to be one and a half feet to one in common earth, and one to one in harder material.

Where the sideling ground is steep, (as in the mountains,) the width of the road, including the ditch on the side hill, will be thirty feet. The stone way still continuing eighteen feet in width, and leaving a foot-path of five feet on the side of the valley, and one of three feet on the hill side, bordered by a ditch four feet wide. The slopes to vary from one and a half to one, to one to one.

The following plan for constructing the stone way, is that upon which the estimates have been made out.

A bed for the reception of the foundation is first excavated eighteen feet in width, by a curved pattern, so that the centre be six inches higher than the ends. Along the two sides of this bed small ditches are cut, from three to six inches wide, and from three to six inches deep. The material of the whole of this excavation is used to raise the summer ways on each side, so that they will slope off from the metalling to the ditches. The small ditches serve for the reception of two rows of curb stones, set upright, so that they project ten inches above the bed. Sound, flat stones are to be selected for this purpose. The curb stones form the sides of the foundation, and prevent it from spreading out; they are essential to the preservation of a good road.

The first layer of stones is regularly and closely packed, in the form of a pavement. The stones are always set upright, and when of a flat form they are set lengthwise across the road. At the same time the broadest end is used as the base, and the rougher and more pointed the tops of the stones are, the better, so that they may the better receive the next layer of broken stone. The thickness of this foundation is to be from five to six inches at the sides, and from six to seven inches in the middle. All kinds of hard stone, as limestone, freestone and graywacke, may be used for the packing.

The second course is to consist of a layer of broken stone, five inches deep at the sides and seven inches deep in the middle. The material may be of the same nature as the packing, but it must be broken so that each stone will pass through a four inch ring. The first portion of this course when spread

over the foundation, must be well rammed into the lower course, by which process the surface of the packing will become consolidated and even.

After the second course has been laid on, and rounded off by a pattern, the third and last course is to be put on, from four to five inches thick at the sides, and from five to six inches thick in the middle. This course will cover the curb stones, and be confined by the summer road or foot ways. The lower part of the top course may consist of broken stone which will pass through a two inch ring; the covering however should not contain stone larger than one and a half inches.

No other material to be used for the third course than limestone or kieselshieffer.* Wherever the latter material can be had within a distance of two miles, it should be prefered to limestone.

The surface of the stone way when finished, will form a curve of nine inches rise in the middle, and slope off on each side. These slopes are continued over the summer ways to the ditches. The whole thickness of the metalling by the above plan will be eighteen inches in the middle, and fifteen inches on the sides. The sectional area will be twenty-five square feet; therefore the cubic content is twenty-five cubic feet, or one perch per lineal foot, or five thousand two hundred and eighty perches per mile.

The cost of metalling and finishing the road as above described, is estimated at $5,800 per mile,† and by allowing this sum, a road may be obtained as good as any in existence, in this country or in Europe. Such a road will be capable of supporting the heaviest traffic, and by adopting a judicious system of constant repair can be kept in the best order at a very moderate yearly expenditure.

The plan for the formation of the stone way here proposed has been extensively used, and with the most perfect success, by the most distinguished European engineers. The main features are the same which were adopted by Messrs. Telford, M'Neill and Wingrove during their extensive practice, and recommended by Sir Henry Parnell, after an experience of twenty years as an active and efficient parliamentary commissioner of roads, in his excellent treatise on this subject, published in 1838. The French engineers have always favored this plan; and several thousands of miles of roads have been constructed upon this principle in Prussia, where its merits have been satisfactorily tested, and where road making is well understood.

It was only owing to the bold and imposing assertions and plausible arguments of Macadam, that the system called after his name, became, to a certain extent, popular, in spite of common sense, and partially superceded the plan established by experience and reason. Macadam's system has everything against it, and nothing to recommend it, and cannot be supported by an experienced and judicious engineer. The parliamentary investigations (pursued with so much patience and sagacity,) instituted for the purpose of

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* This material was found by Mr. Roebling in the course of the survey, west of Tussey's mountain, in great abundance, lying in vertical veins embedded between limestone rock. It is a species of flint, and is considered as the very best material for the upper layar of a stone way. It is almost a pure silex, thefore not liable to produce dirt upon the road, and at the same time it is easily broken. When fractured, its particles, owing to the roughness of their edges, will not give way, but unite into a solid mass. The properties of this valuable material appeer not to be understood by those who have the management of the present road; the coarsely broken limestone, is, under the present system of repairs, preferred, because a road which is never well attended to, and always full of ruts, is more easily and quickly repaired when once reduced to its worst state by throwing on masses of course material which will not yield to the action of the wheels. A road having the upper surface covered with kieselshieffer, requires a little attention constantly, but can with very little care be kept in a high state of preservation, and perfectly smooth at all times. The most valuable material next to kieselshieffer is limestone.

† "Although the expense of constructing a road on this plan may seem to be great, on an average of five years, the joint expense of constructing and repairing such a road will be less than that of constructing and repairing a road made by putting the surface materials on the natural soil, without a paved foundation; for, in point of fact, such a road has usually to be nearly new made every year for some years after it is first opened."—Sir Henry Parnell, on Roads.

ascertaining the most approved form of road making, have drawn from the most skilful and experienced engineers and road surveyors, their opinions relative to the plan pursued by Macadam, and that carried to such perfection by Telford.

After a careful perusal of these investigations, together with the valuable works which have been written upon this subject—and after an attentive observation of the effect of travel, time and wet weather, upon the Macadamized roads in this country—but one opinion can be formed of Macadamization and Telfordization; (the word is used by Dr. Lardner in the course of his examination before the committee of the House of Commons,) the preference must be given to the latter system of road making.

The total cost of grading and bridging from the terminus of the railroad line at the western end of Laughlinstown to Loudon. $99\frac{24}{100}$ miles, is	$506,425 21
Add to this the cost of metalling on the plan proposed, at $5,800 per mile,	575,592 00
	$1,082,017 21

Or $10,903 04 per mile.

If a depth of stone of twelve inches, (instead of eighteen inches,) should be determined upon, the cost would be reduced to $4,000 per mile, so that a road can be made between Chambersburg and Laughlinstown with a stone way far better adapted for rapid travel and heavy wagons than any we have in the State, for $803,385 52. Twelve inches of metalling is more than is usually placed upon turnpike roads, but is equal, when laid on by the plan I propose, to twenty inches placed on in the common way, from the great solidity which the road acquires from the strength of the foundation, and the method of its construction.

Appendix, exhibiting the principles upon which the comparisons between the different routes are predicated, together with the comparisons and their results:

1. REDUCTION OF GRADIENTS TO A LEVEL AND STRAIGHT LINE.

In order to be enabled to enter into the calculations required for ascertaining the cost of transportation and management of a railroad, it becomes first necessary to reduce the gradients and curvature to a level and straight line. The extent of a straight level thus allowed for the gradients and curvature, added to the actually measured distance, will give the *virtual* distance of the line.

The amount of steam power necessary to convey a load over a succession of ascents, is equivalent to the power required for lifting the same load through a perpendicular height equal to the aggregate ascents of the inclines, plus the power to be consumed for conveying the same load over a level distance of the same extent. Now, it is generally admitted that the amount of power which is necessary to raise a load through a perpendicular height of twenty-one feet, is equivalent to what is required for the conveyance of the same load over one mile of level and straight road in the same time. To reduce, therefore, the ascents to a level, we should divide the aggregate rise by twenty-one, and the quotient will express the number of miles to be added to the measured distance. But as the ascents differ in the two directions materially, we should perform the reduction both ways.

When a train descends a plane, the inclination of which is equal to the angle of repose, it is evident that no power from the engine will be required to propel the load; its own gravity will be sufficient to overcome the resistance arising from friction. Now as the engine in so descending exerts no power of traction, it is clear that the additional friction of the engine itself, which

on a level or on an ascent results from this traction, and which amounts to about one pound per ton of load, ceases to exist. We have only to consider the resistance due to the friction arising from the weight of the load, which is established at from eight to nine pounds per ton, and the resistance resulting from the motion of the engine itself, and which amounts to about one hundred and fifty pounds for an engine of ten tons weight.

By dividing 2240 by 9, we obtain $\frac{1}{249}$ one foot rise in a distance of two hundred and forty-nine feet, as the inclination corresponding to the angle of repose for the load, and which is equal to 21·20 feet per mile. The inclination of repose for an engine of ten tons weight, the friction of which amounts to one hundred and fifty pounds, is equal to $\frac{150}{2240}$ or $\frac{1}{149}$, equal to 35·43 feet per mile, which is considerably more than the angle of repose for the load. From this it appears we cannot fix the angle of repose for a descending train, without determining the whole weight of the train.

Suppose the average gross weight of the train itself to be 250 tons, and that of the engine 10 tons. The resistance of the train due to friction is therefore $250 \times 9 =$ 2,250 lbs.

Add the resistance owing to the friction of the engine, 150 "

And we have a total resistance of the train, 2,400 lbs.

The aggregate weight of the train and engine in pounds is $206 \times 2{,}240 = 582{,}400$ pounds. This divided by the total resistance, gives us $582{,}400 \div 2{,}400 = \frac{1}{242 \cdot 66}$ as the rate of inclination which corresponds to the angle of repose for the whole train, and dividing one mile 5,280 feet by 242·66, we obtain 21·76 as the descent per mile equivalent to the angle of repose.

In practice, however, a greater expenditure of steam power will take place, than is required by the above calculation. Where the grades are undulating, the steam power has to be kept up on descent in order to obtain a sufficient accumulation of power to overcome the following ascents. And on long descents, say of 45 feet per mile, safety requires a ready store of power to be applied for reversing the motion of the engine in case of accidents. Some loss of fuel will therefore be incurred from these causes.

No experiments have yet been made by which we can determine the precise amount of steam power required on descending planes, to overcome the resistance of friction and the atmosphere.

On inclinations of less than thirty feet per mile, and on short undulating gradients, from a level to forty-five feet per mile, we may assume the saving of power resulting from a descent of thirty-five feet, as equivalent to the power required on one mile of a straight level. No power will therefore be needed on a descent of 35 feet per mile, or planes exceeding this inclination, provided such descents are of no great extent, and are followed either by ascents, levels, or descents under thirty feet per mile. This principle, however, will not apply to long planes descending more than thirty-five feet per mile. On such descents an actual gain of power, resulting from accelerated velocity, would take place, according to the above supposition. But as it is dangerous to increase the speed beyond certain limits, or to make use of the accelerating force of gravity to its full extent on steep inclines, nothing will be gained from any excess of gravity, but what is wanted to overcome the friction of the train.

In such cases, as for instance on the eastern descent of the Allegheny mountain, from the west to the east, we should allow, say fifty feet of descent, as equivalent to one mile of level in point of expense of steam power. Or the amount of steam power required on one mile of road, descending forty-five feet, is equivalent to the power expended upon a straight and level road of $\frac{50-45}{50}$ or $\frac{1}{10}$ of a mile in length.

2. REDUCTION OF CURVATURE.

To exhibit the effect which the curvature of the road will have upon the locomotive power, we will adopt, as a basis for our calculations, the result of experiments which were made for that purpose by the engineers of the Baltimore and Ohio railroad.

The resistance arising from a curvature equivalent to three hundred and sixty degrees of deflection, was found to be equal to the amount of resistance of a straight and level line of 0·238 miles. The mechanical resistance arising from the curvature of a line, will, therefore, be equivalent to the resistance of a level and straight line, the extent of which is obtained by dividing the aggregate sum of degrees of deflection by 360, and multiplying the quotient by 0·238.

FUEL.

The quantity and cost of fuel for transportation at different speeds has been ascertained and nearly reduced to a certain standard on different roads in this country and in England. From these facts, we have, with a due regard to circumstances, allowed one-fifth of a cent as the average cost of fuel for the conveyance of one ton gross weight of passenger trains, over one mile of level and straight road, at a velocity of twenty miles per hour; and one-tenth of a cent as cost of fuel for one ton of freight train, over one mile of level and straight road, at a velocity of ten miles per hour.

COST OF MACHINERY AND WEAR AND TEAR.

The wear and tear of the machinery will be nearly in proportion to the work performed. Now, as its capacity will be nearly regulated to the grades, the wear and tear may be estimated in proportion to the actual running distance, including the equation for the curvature of the road.

The annual expense of wear and tear, and depreciation of a locomotive engine and tender for passenger trains, will be assumed at	$2,500
And the engine and tender for freight trains, at	2,000
Of a passenger car, including oil,	500
Freight, " "	145

REPAIRS AND SUPERVISION OF ROAD.

The annual repairs of the graduation, culverts, and double railway track, including the supervision of the road, is estimated at $800 per mile. The annual repair of the wood-work of viaducts is estimated at 4 per cent. on the first cost.

TO PHILADELPHIA.

No. 1.	Projected railroad from Cleveland to Pittsburg,	130·00	miles.
	Harrisburg and Pittsburg railroad, (middle route,)	229·57	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Cleveland to Philadelphia,	466·32	miles
	Maximum gradient, 45 feet per mile.		

TO BALTIMORE.

No. 2.	Projected railroad from Cleveland to Pittsburg,	130	miles.
	Baltimore and Ohio railroad,	337	"
	Total distance from Cleveland to Baltimore,	467	miles.
	Maximum gradients, 84 and 66 feet per mile.		

TO NEW YORK.

No. 3.	From Cleveland to Philadelphia as by route No. 1,	466·32	miles.
	From Philadelphia to New York by railroad,	85	"
	Total distance from Cleveland to New York,	551·32	miles.
	Maximum gradient, 45 feet per mile.		

TO PHILADELPHIA VIA ERIE.

No. 4.	By lake, from Cleveland to Erie,	120·00	miles.
	By Sunbury and Erie railroad,	286·56	"
	By Sunbury and Catawissa, Little Schuylkill and Susquehanna, Little Schuylkill and the Reading railroads,	148·44	"
	Total distance from Cleveland to Philadelphia,	555·00	miles.
	Maximum gradient, 66 feet per mile.		

TO NEW YORK VIA DUNKIRK.

No. 5.	By lake from Cleveland to Dunkirk,	170	miles.
	By New York and Erie railroad,	448	"
	By Hudson river, from Piermont to New York,	22	"
	Total distance from Cleveland to New York,	640	miles.
	Maximum gradient, 60 feet per mile.		

TO BOSTON VIA BUFFALO.

No. 6.	By lake from Cleveland to Buffalo,	210	miles.
	By Batavia and Buffalo railroad,	36	"
	By Rochester and Batavia "	33	"
	By Auburn an Rochester "	78	"
	By Syracuse and Auburn "	26	"
	By Utica and Syracuse "	53	"
	By Utica and Schenectady "	78	"
	By Mohawk and Hudson " (to Albany,)	16	"
	By Western "	157	"
	By Boston and Worcester "	44	"
	Total distance from Cleveland to Boston,	731	miles.
	Maximum gradient, 80 feet per mile.		

TO NEW YORK VIA BUFFALO.

No. 7.	By lake to Buffalo,	210·00	miles.
	By railroads from Buffalo to Albany, as by route No. 6 and by the New York and Albany railroad,	467·71	"
	Total distance from Cleveland to New York,	677·71	miles.
	Maximum gradient, 60 feet per mile.		

TO PHILADELPHIA.

No. 8.	Total distance by railroads as by route No. 4,	435	miles.
	Maximum gradient, 66 feet per mile.		

TO PHILADELPHIA.

No. 9.	Projected railroad via Meadville, Allegheny river, Kiskiminetas and Conemaugh, to the middle route,	171·00	miles.
	Middle route, from the point of intersection, to Harrisburg,	187·25	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Erie to Philadelphia,	465·00	miles.
	Maximum gradient, $52\frac{80}{100}$ feet per mile.		

TO NEW YORK VIA DUNKIRK.

No. 10.	By lake to Dunkirk,	50	miles.
	From Dunkirk by New York and Erie railroad, and by Hudson river, as by route No. 5,	470	"
	Total distance from Erie to New York,	520	miles.
	Maximum gradient, 60 feet per mile.		

TO NEW YORK VIA BUFFALO.

No. 11.	By lake to Buffalo,	90·00	miles.
	Railroads as by route 7,	467·71	"
	Total distance from Erie to New York,	557·71	"
	Maximum gradient, 60 feet per mile.		

TO BOSTON VIA BUFFALO.

No. 12.	By lake to Buffalo,	90	miles.
	Railroads as by route 7,	521	"
	Total distance from Buffalo to Boston,	611	miles.
	Maximum gradient, 80 feet per mile.		

TO NEW YORK—BY RAILROAD AND RIVER.

No. 13.	New York and Erie railroad,	448	miles.
	Hudson river from Piermont to New York,	22	"
	Total distance from Dunkirk to New York,	470	miles.
	Max. gra. 60 ft. pr mile, from Elmira to N. York.		

TO PHILADELPHIA—BY RAILROAD.

No. 14.	New York and Erie railroad to Elmira,	194·00	miles.
	Williamsport and Elmira railroad,	74·00	"
	Northern route of the Harrisburg and Pittsburg railroad, as located from Williamsport to Harrisburg,	91·50	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Dunkirk to Philadelphia,	466·25	miles.
	Max. gra., 45 ft. pr mile, from Elmira to Phila.		
No. 15.	Total distance from Buffalo to New York by the railroads to Albany, as by route 7, and the New York and Albany railroad,	467·71	miles.
	Maximum gradient, 60 feet per mile.		
No. 16.	Total distance from Buffalo to Boston, as by railroads in route 6,	521	miles.

TO NEW YORK.

No. 17.	From Buffaly, by the grand Erie canal and the Hudson river,	508	miles.

TO PHILADELPHIA FROM ERIE.

No. 18.	Erie extension of the Pennsylvania canal,	104·50	miles.
	Beaver division, " " "	30·75	"
	Ohio river to Pittsburg,	26·00	"
	Western division of the Pennsylvania canal,	104·00	"
	Portage railroad, " " "	36·00	"
	Juniata division, " " "	127·50	"
	Eastern, " " "	44·50	"
	Philadelphia and Columbia railroad,	82·00	"
	Total distance from Erie to Philadelphia by State improvements,	556·25	miles.

TO PHILADELPHIA FROM CLEVELAND.

No. 19.	Ohio canal from Cleveland to Akron,	38	miles.
	Pennsylvania and Ohio canal to Beaver division,	84	"
	From point of junction of P. and O. canal, by Beaver division, to the town of Beaver on the Ohio river,	22	"
	Ohio river to Pittsburg,	26	"
	Western division, Portage railroad, Juniata division, Eeastern division and Columbia railroad,	394	"
	Total distance from Cleveland to Philadelphia,	564	miles.

RAILWAY TRAFFIC IN ENGLAND.

We give the annexed extract from the London Railway Magazine, of 29th April, to show the immense amount of travel in Great Britain, by railways. *Twenty millions* of passengers carried on railways, besides all other modes of conveyance, and at a cost of £4,000,000 a year. It will be hardly credited here—though probably within the truth.

"The following calculation of the last weekly returns of 44 railways, 1,560 miles in length, given in our present number, will, we believe, be of interest: number of passengers on 28 railways, 327,142, consequently the total for the week must be about 500,000. The receipts for passengers on 44 railways, £68,832 17s. 3d.; ditto for goods on 39 railways, £22,526 10s. 11d.; total, £91,359 8s. 2d. This is an average of £58½ per mile per week. The traffic, therefore, is certainly at the rate of about four millions and a half a year, and carrying twenty millions of passengers.

NAME.	Passengers per week.	Total receipts.	Total 1842.
Brimingham and Derby,		£1337	£1062
Birmingham and Gloucester,		1759	1508
Brandling Junction,	11,562	795	745
Chester and Birken,	3,839	495	455
Dublin and Kingstown,	32,178	764	874
Durham and Sunderland,	2,864	599	
Edinburgh and Glasgow,	10,039	2014	2072
Eastern Counties,	20,183	2304	891
Glasgow and Ayr,	15,107	1070	956
Glasgow and Greenock,	16,129	687	658
Grand Junction and Ch. and Cr.,		6956	8636
Great North of England,		1407	1304
Great Western,	33,625	13723	12951
Hull and Selby,	4,173	1,085	960
Liverpool and Manchester,		3795	3833
London and Birmingham,		15859	16313
London and Blackwall,	42,131	682	848
London and Brighton,	11,820	3435	2232
London and Croydon,	4,627	308	443
London and Greenwich,	24,610	773	830
London and South Western,		6169	6041
Manchester, Bolton, and Bury,		672	573
Manchester and Birmingham,		3037	352
Manchester and Leeds,		4742	4228
Midland Counties,	10,264	2544	2424
Newcastle and Carlisle,		1264	1345
Newcastle and North Shields,	16,556	360	312
Northern and Eastern,	12,480	1615	1345
North Midland,		4133	3988
North Union,	2,387	985	931
Preston and Wyre,	1,108½	179	137
Sheffield and Manchester,	20,691	522	282
South Eastern,	7,219	2052	
Ulster,	9,046	597	439
York and North Midland,	7,410	1596	1568

The entire length of these 44 railroads is only 1560 miles, whereas we

shall have within 15 years, a line of road, under a uniform system of management, of a thousand miles in length.

CANAL BETWIXT CAIRO AND SUEZ.

We learn, on the authority of a correspondent at Cairo, that the Pasha has determined on constructing a canal between that city and Suez, and that the work is to be commenced forthwith. It is expected that this undertaking will not prove so arduous as at first sight may appear; in many places all that is requisite to be done being merely to clear out the bed of the ancient canal; and as Mehemet Ali has now turned his sword into a ploughshare, it is not improbable he may find employment for some of his troops on the work. The following particulars of this ancient canal may not be uninteresting to our readers:

The great Sesostris appears to have been the first who conceived the project of uniting the Nile to the Red Sea by means of a canal, and actually commenced this gigantic enterprise, which, however, he did not finish. At a subsequent period it was resumed by one of his successors, Pharaoh Necho, on which occasion 120,000 men perished. It was not, however, then completed, in consequence of the response of the oracle, which was consulted by that monarch, to the effect that "the construction of the proposed canal would expose Egypt to the invasion of foreigners." During the dominion of the Persians, however, it was continued by Darius, the son of Hystas pes, and finally completed by Ptolemy Philadelphus, after whom it was named. The geographer Strabo relates that it "was furnished with ingeniously contrived sluices, which were opened to admit the passage of vessels, and afterwards very promptly shut." It was 140 miles long, 60 yards wide, and 30 feet deep. It commenced at the Pelusiac, or most easterly branch of the Nile, near Bubasatis, (about 35 miles north of Cairo,) and after flowing through the lake Amer, like the Rhone through the lake of Geneva, it terminated at Assinie, a town near the site of the modern Suez, By means of this canal, vessels from the Red sea, when they reach the Pelusiac branch of the Nile, could either descend to the Egyptian ports of the Mediterranean, or ascend the river to Memphis and Thebes. By furnishing an abundant supply of water for irrigation, it fertilized the desert on both sides of its banks, which were soon covered with opulent cities, among which may be mentioned Phagroniopolis, Heroopolis and Serapeum, the positions of which are indicated in our chart.

During the Roman dominion in Egypt, this canal was renewed or repaired by the Emperor Trajan, who added a branch to it, which communicated with the Nile near old Cairo. This prolongation of the canal bore the name of the Emperor, as is explicitly stated in the following passage: "Between Heliopolis and Babylon, (old Cairo) flows the river Trajan."

Our correspondent does not inform us whether it is in contemplation to renew the whole of these canals, or what deviation is contemplated in consequence of the Pelusiac branch of the Nile being now dried up, except that the point of junction with the Nile is to be at Shubra, in order that the city of Cairo may derive benefit from the undertaking.

We may add that, although our correspondent was assured on very good authority that the work is to be commenced immediately, he is rather skeptical as to the means possessed by the Pasha of carrying it into immediate execution.

Safe Travelling.—The Newburyport Herald says, that "On the 17th of June, ten thousand passengers were transported without the slightest ac-

cident, over the whole line of 100 miles of the Eastern railroad, by day and night. Eighteen regular trains beside some extras were run on the road, commencing at 4 o'clock in the morning and continuing until after midnight.

The following article, well worth the attention of engineers and others interested in the improvement of the locomotive, was sent to us several months ago, but by accident was not received. It has since been published in another journal, but as we are desirous of placing it upon our pages, we have thought proper to make this explaination.

LETTER FROM CHARLES MOERING, ESQ., ENGINEER, TO MESSRS. EASTWICK & HARRISON, LOCOMOTIVE BUILDERS CORNER OF TWELFTH AND WILLOW STS., PHILADELPHIA.

Gentlemen—In complying with your request to give you my opinion about your locomotive engines, I feel called upon to state the grounds that make this opinion what it is.

I do this in view of the interests of science, not intending to pass a mere encomium upon the productions of your establishment. Every engineer is, no doubt, conversant with the fact, that the power of a locomotive engine not only depends on the harmonious proportions of boiler and cylinders, and on the clever mechanical arrangement to work the pistons and transfer motion to the driving wheels; but every engineer must be also aware of the importance of another fact, viz: *the manner in which this power is made available in order to draw a maximum load, at a maximum speed, on a railroad.*

In examining this point, we find that a fulcrum is required to enable the steam power to act upon the weight, or the load to be drawn. This fulcrum in the locomotive engine, is evidently the grip of the driving wheels on the rails, meaning the friction between both, or *adhesion*, as it is technically called. Let a locomotive engine be ever so powerful, but take away the aforesaid friction, and the wheels will slip, the engine will draw nothing. This adhesion, derived from the pressure of the weight of the engine, must, therefore, bear a certain proportion to the latter. Its maximum will be obtained by throwing the largest, its minimum by placing the smallest amount of the engine's weight on the driving wheels. The minimum, however, has at no time been a desideratum, as the largest amount of adhesion is required for enabling an engine of a given power to draw a maximum load at a maximum speed.

In the six wheeled American engine, the true offspring of American mechanical talent, as possessing a fore truck, which affords a most opportune facility for turning curves, there is but *one* axle to bear the aforesaid proportion of weight; and this axle is the driving axle. On its position, therefore, depended the amount of weight to be made available for producing friction. As it was found impossible, as well as improper in practice, to place this *single* driving axle under the centre of gravity, for the purpose of equilibrating the entire weight of the engine, there remained but two other positions, viz: *behind and close before the fire box.*

To illustrate the effect in both cases, let us suppose two engines, A and B, each of 12 tons weight in running order, with cylinders, boilers and driving wheels of the same dimensions, and performing the same amount of duty on two roads of exactly the same kind.

In the engine A, with the driving axle *behind* the fire box, it was found that only *half* of its weight was brought into action for the purpose of pro-

ducing friction, amounting in this case to $\frac{12}{2}=6$ tons.

In the engine B, with the driving axle *before* the fire box, *two-thirds* were found available for the same purpose, equal to $\frac{2\times12}{3}=8$ tons. The ratio of *adhesion* is, therefore, A : B=6 : 8, meaning that the engine B possesses a surplus of two tons in its adhesive power, *and, consequently, in its capability of drawing loads.*

In further examining our subject, another question arises, concerning the effect of the given ratio of adhesion on the rails. In the engine A we have, as mentioned, six tons on the driving axle, and, therefore, three tons on each driving wheel. In the engine B, however, we find eight tons on the driving axle, and, consequently, four tons on each driving wheel. The proportion of *weight* on the rails is, accordingly, A : B=3 : 4.

Supposing these two engines to run at the same speed, S, and assuming the stress by impact upon the rails to be represented approximately by the speed multiplied into the weight imposed upon each driving wheel, then each line of rails would be percussed by A, with $S\times3=3S$, and by B, with $S\times4=4S$.

This gives a ratio of *impact* A : B=3S : 4S or A : B=3 : 4; meaning, for the sake of practical illustration, that the engine B will ruin the rails, take them to be thirty-eight pounds per yard, after the lapse say of nine years; while the engine A will produce the same deterioration only after the space of twelve years, supposing the amount of traffic and other conditions to be the same in both cases.

Although no actual observations of this nature have been made with regard to the rails, yet the average duration of the wrought iron tires on the driving wheels, proves the above proportion not to be an incorrect one. The duration of tires on engines, with the driving axle *behind* the fire box, has been found to exceed the duration of those on engines with the driving axle *before* the fire box; and taking the latter to be nine months at an average, the duration of the first has been found to amount to from twelve to fourteen months.

Wronght iron rails being manufactured in the same way as tires, it can be but a fair assumption, that the duration of rails will admit of the same proximate scale given in the above proportion of impact.

This brief exposition, backed by the ratio of *tractive power*, A : B=6 : 8, and by the proportion of *duration*, A : B=3 : 4, makes it obvious why the *diminution of impact* in the engine B, possessing a superior power of traction, was found of such great importance, and has thus constantly occupied the attention of the American machinists and engineers. In pursuance of this notion, the eight wheeled engine was started with *two* driving axles, one *before* and the other *behind* the fire box.

Supposing such an engine C, to weigh twelve tons, in running order, and of the same dimensions as A and B, the weight on the two driving axles was found to be also *two-thirds*, or eight tons, yet pressing upon the road, on the four points of contact, only with $\frac{8}{4}=2$ tons.

The proportion of *adhesion*, or *tractive power*, is, therefore, A : C=6 : 8, B : C=8 : 8, A : B : C=6 : 8 : 8.

The ratio of *impact*, or *deterioration of the rails*, being C : A=2 : 3, C : B=2 : 4, C : A : B=2 : 3 : 4.

From this we may infer that rails lasting but nine years under the performance of the engine B, and twelve when traveled upon by the engine A, will not meet with their ulterior destruction before eighteen years, when engines of the kind C, are running upon them under the aforementioned suppositions.

I can, therefore, but applaud your resolution of building systematically no other engines but those with eight wheels—four driving and four truck wheels. However, I feel myself called upon to impress you with the advantages that must necessarily result when the number of driving wheels can be augmented to six or eight, without loosing that beautiful characteristic of the American engine, viz: *the free vibrating truck*, which in its office of piloting the engine along the track, I think invaluable for the American railroads, with their sharp turns and light superstructure.

An engine, D, with *three*, and an engine, E, with *four* driving axles, lending an opportunity to make their *whole* weight available for adhesion, which then would be that due to the maximum weight of twelve tons, in the given case, would certainly possess the greatest tractive power, and yet injure the road in a much less degree. The proportions of adhesion, or tractive power, would be the following ones, supposing in every case that the engine possesses sufficient power to slip her wheels in pulling against a fixed point, A : B : C : D : E=6 : 8 : 8 : 12 : 12; and the proportions of impact, or deterioration of the rails, B : A : C : D : E=4 : 3 : 2 : 2 : 1½.

I am aware of all the difficulties attending what I propose, but I feel, nevertheless, confident that "flexible coupling rods," permitting all the axles, with the exception of the main driver, to conform to the radii of curves, are within the pale of practical feasibility. Only on this condition should I think myself justified in preferring engines with a greater number of driving axles than two, were I even inclined to overlook the greater complication that such a mechanical arrangement must require. I reckon simplicity to be one of the cardinal virtues in any mechanical apparatus, and of the most absolute necessity in the locomotive engine.

After this digression, permit me, gentlemen, to come back to the *eight wheeled engine*, C, as the subject of my disquisition. Great as the improvement promised to be, in introducing the aforesaid engine, the advantages derived thereform for the preservation of the rails, were, however, nearly lost. The difficulty consisted in the stiff connection of the fire box, boiler, smoke box, and pedestals of the driving wheels, with the frame, which acted like a lever. Whenever one pair of driving wheels was raised, by some irregular elevation in the track, resulting from its bad condition, the other pair, in consequence of the springs not acting quick enough to force them down, were momentarily lifted up by the frame, consequently without bearing their due proportion of weight; and, on the contrary, when one pair was passing over a depression in the road, the other again, for the same reason, had to sustain nearly the whole amount of weight originally allotted to both driving axles—the truck wheels always acting as a fulcrum, and the frame, with its fixed pedestals and the axles therein revolving, as the lever.

This could not help injuring the road nearly in the same degree as the engine B; nay, the effects were still more injurious to the engine C, itself, as in the case of the main driving axle being suspended by the frame, in one of the aforesaid elevation or depressions of the other driving axle, the former received its rotary motion from the pistons without its fulcrum or adhesion to the rails.

It is but just to say, gentlemen, that you saved the eight wheeled engine from becoming a mere notion, and that owing to your exertions, it has been

brought to such a state of perfection as ought to make the old six wheeler, of the kinds A and B, quite absolete. It is furthermore, but justice to state, that your special adaptation of the lever, or balancing beam, to the use of locomotives upon railways, obviated the aforesaid difficulties in such a manner as to leave but little to desire; and here I regret to say, that some of the northern railroads in Germany—notwithstanding the unqualified recommendation of so able an engineer as Mr. C. E. Detmold—have not adopted engines with your improvement.

I consider the balancing beam, supported in its centre by a vertical shaft, resting on springs that are attached by the pedestals to the frame, and stayed on its ends by two vertical pins abutting against the two driving axles, as possessing, in an eminent degree, the two indispensable qualities—*first*, of equalizing the weight on both driving axles, in whatever condition the road may be, and, therefore, producing in an eight wheel engine of twelve tons, a constant and equal adhesion of eight tons, yet pressing the rails with but two tons; and, *second*, of furthermore diminishing the very ratio of impact as given above, the weight of the engine being suspended in the middle of the lever beam, causing it to fall only half the depth of any of the driving axles, in their passage over any short or sudden depression in the track, while the engines A and B must go down the whole depth, as supported by one axle alone, which by increasing the height of fall, must add to the power of the percussion, and, therefore, ruin the road even in a shorter period than the proportionate number of twelve or nine years.

But this is not alone what distinguishes your engines, the balancing beam of your arrangement being now used by nearly all the engine builders of note in the United States, after having purchased the patent right from you, which at once bespeaks the great merit and usefulness of your improvement.

It is, besides, the very simplicity of your engines that must engage the attention of even the least observing. Instead of four eccentrics, four eccentric rods, four latches, and a complicated arrangement to put them in and out of gear, by an extra hand lever, thus making three hand levers altogether, you have but two eccentrics, two eccentric rods, no latches, and a simple arrangement of the reversing valve; the whole to be handled by one and the same lever, and this, too, by moving it in exact accordance with the required movement of the engine.

It is true that in reversing you lose in speed, as the lead of the slide no longer takes place; but this loss I think of no moment, as it only happens when the engine is backing. Besides, the position of your forcing pumps is such as to prevent the freezing of the water, an advantage of great importance with locomotion in northern climes.

Gentlemen, this is my canded opinion about your eight wheeled engines, and you are welcome to make any use of this document. Permit me to avail myself of this opportunity to thank you for your readiness, and the frank and open way in which you satisfied my desire for information; and allow me to assure you that the modest and unostentatious manner in which you spoke of your engines, trusting more to their own merits than to puffing and boisterous recommendations, has most favorably impressed me with your own personal character. I am, gentlemen, your's, respectfully,

CHARLES MOERING,

Captain of Engineers in the Austrian Army.

Philadelphia, September 1st, 1842.

DESTRUCTION OF THE ROUND-DOWN-CLIFF BY GUN-POWDER.

You will not be surprised to hear that the announcement that an explosion

of 18,000 lbs. of powder was to be made in the Round Down Cliff this afternoon brought in an influx of stangers into this town; still, though considerable, it was not so large as I had expected. Curiosity was, I think, paralyzed by a vague fear of danger, which kept some thousands at home who might have witnessed it, as the event turned out, without the slightest shock to their nervous system. The experiment succeeded to admiration, and, as a specimen of engineering skill, confers the highest credit on Mr. Cubitt, who planned, and on his colleagues who assisted, in carrying it into execution.

Everybody has heard of the Shakspeare Cliff, and I have no doubt that a majority of your readers have seen it. I should feel it a superfluous task to speak of its vast height were not the next cliff to it, on the west, somewhat higher. That cliff is Round Down Cliff, the scene and subject of this day's operations. It rises to the height of 375 feet above high water mark, and was, till this afternoon, of a singularly bold and picturesque character. To understand the reasons why it was resolved to remove yesterday no inconsiderable portion of it from the rugged base on which it has defied the winds and waves of centuries, I must make your readers acquainted with the intended line of railway between Folkestone and this place.

At Folkestone there will be a viaduct of great height and length. Then there will be a tunnel, called from a martello tower near it, the Tower Tunnel, one third of a mile in length. Then comes a cutting through the chalk of two miles in length, called Warren's cutting. Then comes the Abbott's Cliff tunnel, one mile and a quarter in length, and now half finished, although only commenced on the 16th of August last. From the Abbott's Cliff tunnel to the Shakspeare Cliff tunnel the railroad will be under the cliffs close to the sea, and protected from it by a strong wall of concrete two miles long, and with a parapet of such a height as will not preclude passengers from the splendid marine view which lies under them. Now it was found that when a straight line was drawn from the eastern mouth of the Abbott's cliff tunnel to the western mouth of the Shakespeare tunnel, there was a projection on the Round Down cliff which must be removed in some way or other to insure a direct passage. That projection, seen from the sea, had the appearance of a convex arc of a circle of considerable diameter. It is now removed, and some idea of its size may be formed from the fact that a square yard of chalk weighs two tons, and that it was intended by this day's experiment to remove 1,000,000 tons. The Shakspeare tunnel is three-quarters of a mile long, and it is about the same distance from that tunnel to the town of Dover.

Having premised thus much as to the locality of Round Down cliff, I now proceed to describe, as briefly as I can, the means employed to detach from it such an immense mass of solid matter. A horizontal gallery extended for about 100 yards parallel with the intended line of railway, from which cross galleries were driven from the centre and extremes. At the end of these cross galleries shafts were sunk, and at the bottom of each shaft was formed a chamber, 11 feet long, 5 feet high, and 4 feet 6 inches wide. In the eastern chamber were deposited 5000 lbs. of gunpowder, in the western chamber 6000 lbs., and in the centre chamber 7000 lbs., making in the whole 18,000 lbs. The gunpowder was in bags, placed in boxes. Loose powder was sprinkled over the bags, of which the mouths were opened, and the bursting charges were in the centre of the main charges. The distance of the charges from the face of the cliff was 70 feet at the centre and about 55 feet at each end. It was calculated that the powder, before it could find a vent, *must* move 100,000 yards of chalk, or 200,000 tons. It was also confidently expected that it *would* move 1,000,000 tons.

The following preparations were made to ignite this enormous quantity of powder. At the back of the cliff a wooden shed was constructed, in which three electric batteries were erected. Each battery consisted of 18 Daniels' cylinders, and two common batteries of 20 plates each, to which were attached wires which communicated at the end of the charge by means of a very fine wire of platina, which the electric fluid as it passed over it, made red hot, to fire the powder. The wires covered with yarn were spread upon the grass at the top of the cliff, and then falling over it were carried to the eastern, the centre, and the western chamber. Lieutenant Hutchinson of the Royal engineers, had the command of the three batteries, and it was arranged that when he fired the centre, Mr. Hodges and Mr. Wright should simultuneously fire the eastern and western batteries, to ensure which they practised at them for several previous days. The wires were each 1,000 feet in length, and it was ascertained by experiment that the electric fluid will fire powder at a distance of 2,300 feet of wire. After the chambers were filled with powder, the galleries and passages were all *tamped* up with dry sand, as is usually the case in all blasting operations.

At 9 o'clock A. M., a red flag was hoisted directly over the spot selected for the explosion. The wires were then tested by the galvanometer, the batteries were charged, and every arrangement completed for firing them.

It was arranged that the explosion should take place at 2 o'clock; at that time there was an immense concourse of people assembled. In a marquee erected near the scene of operation, for the accommodation of the directors and distinguished visitants, we observed among the number assembled, Sir John Herschell, General Pasley, Colonel Rice Jones, Mr. Rice, M.P., Professors Sedgwick and Airy, the Rev. Dr. Cope, and there was also a strong muster of engineers, among whom were Mr. Tierney Clark, Mr. John Braithwaite, Mr. Charles May, Mr. Lewis Cubitt, and Mr. Fred. Braithwaite; the engineers and directors of the Greenwich, Croydon, Brighton, and South Eastern railways, besides numerous foreigners of eminence.

At 10 minutes past 2, Mr. Cubitt, the company's engineer in chief, ordered the signal flag at the western marquee to be hoisted, and that was followed by the hoisting of all the signal flags. A quarter of an hour soon passed in deep anxiety. A number of maroons, in what appeared to be a keg, was rolled over the cliff, and on its explosion with a loud report, all the flags were hauled down. Four more minutes passed away, and all the flags except that on the point to be blasted were again hoisted. The next minute was one of silent and breathless and impatient expectation. Not a word was uttered, except by one lady; who when too late, wished to be at a greater distance. *Galeatum sero duelli pœnitet.* Exactly at 26 minutes past 2 o'clock a slight twitch or shock of the ground was felt, and then a low, faint, indistinct, indescribable moaning subterranean rumble was heard, and immediately afterwards the bottom of the cliff began to belly out, and then almost simultateously about 500 feet in breadth, with reference to the railway's length of the summit began gradually to sink.

There was no roaring explosion, no bursting out of fire, no violent and crashing splitting of rocks, and what was considered extraordinary, no smoke whatever; for a proceeding of mighty and irrepressible force, it had little or nothing the appearance of force. The rock seemed as if it had exchanged its solid for a fluid nature, for it glided like a stream into the sea, which was at a distance of about 100 yards, perhaps more, from its base, tearing up the beach in its course, and forcing up and driving the muddy substratum together with some debris of a former fall, violently into the sea, and when the mass has finally reached its resting place a dark brown color was soon

on different parts of it, which had not been carried off the land; the shattered fragments of the cliff are said to occupy an area of 15 acres, but we should judge it to be much less. I forgot to minute the time occupied by the descent, but I calculate that it was about four or five minutes. The first exclamations which burst from every lip was, "Splendid, beautiful!" the next were isolated cheers, followed up by three times three general cheers from the spectators, and then by one cheer more. These were caught up by the groups on the surrounding downs, and, as I am informed, by the passengers in the steamboats. All were excited, all were delighted at the success of the experiment, and congratulation upon congratulation flowed in upon Mr. Cubitt for the magnificent manner in which he had carried his project into execution.

As a proof of the easy, graceful and swimming style with which Round Down Cliff, under the gentle force and irresistible influence of Plutus and Pluto combined, curtseyed down to meet the reluctant embraces of astonished Neptune, I need only mention that the flagstaff, which was standing on the summit of the cliff before the explosion took place, descended uninjured with the fallen debris.

No fossil remains of the slighest importance were brought to light, which was a matter of disappointment to many. A very few even of the most ordinary character were found among the mass, which it may well be imagined was soon after the explosion, teeming with the curious multitude from the cliffs above, anxious to obtain some relic of the event.

On examining the position occupied by the debris of the overthrown cliff, we were much pleased to find it more favorably disposed than we could have conceived possible. Instead of occupying the site of the proposed railway at the foot of the cliff, it had by its acquired velocity slid past it, and left comparatively little indeed to be removed. At some considerable distance from the cliff, the fragments appeared to be heaved up into a ridge, higher than any other part, forming a small valley towards the cliff, and another seaward, beyond which a second ridge appeared, when it finally slopes off towards the sea. The chalk was by no means hard, and appeared thoroughly saturated with water. The great bulk of the fragments ranged from about two to perhaps eight or ten cubic feet, although we observed a vast number of blocks, which contained from two to three cubic yards and upwards, one of which was driven some distance into the Shakspeare tunnel without doing injury to the brickwork. There was very little, indeed, of what might be termed rubbish in the mass.

Previous to the explosion, we had heard it stated that about a million yards were expected to be detached; indeed the Railway Times so stated it, on the 21st ultimo, apparantly from authority, and after the explosion took place, it was publicly asserted by one of the officials, that three quarters of a million of cubic yards had come down. Now, on cubing the stated dimensions of the mass, which were given as under 300 feet in height by say 50 feet longer than the gallery, which would therefore be 350 feet, by an average thickness or depth from the face of the cliff of 60 feet, we shall have 233,333 cubic yards; but as the present face slope of the cliff is greater than before, the average thickness perhaps might be increased to 75 feet, which would make the quantity 291,666 cubic yards, from this is to be deducted 50,000 yards, the estimated quantity to be now shifted in forming the road, we shall then have 30,000 yards effectively removed by the expenditure of one ton of powder. We understand that Mr. Cubitt, the engineer, afterwards stated that a saving of six months' work and £7,000 expenditure was effected by this blast. Now allowing 6d. per yard for the removal of the quantity now

required to be shifted, which would amount to £1,250, and £500 for the powder used in the blast, the cost of forming the galleries, tamping, etc., we shall find that this mass has been removed at a cost of 1·44 pence per yard. Again, taking Mr. Cubitt's statement, that a saving has been effected of $7,000, to which, if we add the £1,750, expenditure by the present plan, we shall find that he estimated the cost of removal by hard labor, at rather less than 7½d. per yard.

We felt an interest in examining the beds and fissures of the chalk in the neighborhood of this blast, which clearly indicated that the plan of removal adopted by Mr. Cubitt, was not only the cheapest, but the safest method which could have been adopted. The vertical fissures which here traverse the chalk appear to lie pretty nearly parallel, and at a slope perhaps of one-fifth to one-tenth to one. It was in one of these fissures that the whole mass parted and slipped down, on which we believe it had set previously, no doubt brought about by the infiltration of water more than the sapping of the base by the sea. So treacherous, indeed, was this chalk, that if we are rightly informed, a mass equal nearly in bulk to that blasted on Thursday came down unexpectedly some time since in the night time, burying in its ruins a watchman or foreman belonging to that part of the line. In the zigzag gangways cut along the face of the cliff, to enable persons to ascend to the summit—this sliding of the chalk where those vertical fissures are intersected, appears very frequently, inspiring the passer-by with a feeling of great insecurity. How far the water might be intercepted, or otherwise be prevented from filtering through these fissures is a question of great importance, and would not, we think, be one of difficult remedy. It also becomes a matter of interesting inquiry as to the effect which a lesser quantity of powder would have had, deposited and fired in the same manner. Would it only have made the mass insecure, or caused a partial sliding down, rendering it then more difficult of removal by hand than at first? The proportion of powder which Mr. Cubitt employs in his blasting operations we understand is determined thus: "The cube of the line of least resistance in feet, gives the quantity in half ounces;" but in this case there does not appear to have been any such quantity employed, though much more than heretofore is found necessary in usual blasting operations. Perhaps the most curious circumstance, connected with the operation, was the apparent absence of shock on the firing of the charge on some spots in the immediate vicinity, while at other, far more distant, it was clearly perceptible. Thus, where the batteries were placed, those in charge of them thought the charge had missed fire, from their being insensible to any shock, while at five times the distance along the face of the cliff, it was clearly felt. But even along the face of the cliff it was very evident that the shock was felt by some and not by others, though standing within a few yards of each other.

Junction of the Rhine and Danube.—The canal connecting these two great rivers of Europe, was nearly completed at the last accounts. It was to have been opened for navigation in a few days, between Nuremburg and Bamberg, and shortly after, through its whole extent, from Danube to Mayn.

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AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 4, Vol. I. Third Series. | APRIL, 1843. | Whole No. 423, Vol. XVI.

The resolution of the legislature of New York calling for information from Railroads, is given below. This movement will procure the annual publication of a series of returns, similar to those made to the Massachusetts legislature, and which have materially influenced the character of railroads by presenting in a condensed form the *accurate* results of each years' operation—which results have uniformly proved highly favorable to the reputation of railroads. Viewed in this light we may pronounce this an important step in the progress of railroads in our State.

STATE OF NEW YORK. IN ASSEMBLY, FEBRUARY 2, 1843.

On motion of Mr. Hathaway—*Resolved*, That the several railroad companies in this State be and are hereby required to make their annual reports to the Secretary of State, by the first day of February in each year, which reports shall embrace the business of the preceding year to the first day of January, and shall state the length of their road in operation; cost of construction; income from passengers, from freights and from all other sources; the number of through and way passengers, and the receipts from each class; their expenses for repairing and running the road and for construction, which two items shall include all their expenditures; the amount of dividends; the number of locomotives; of passenger, freight, mail and other cars; the number of machine shops; the number of horses; the average number of men in the employment of the company; the number of miles run by passage trains, by freight and all other trains; and that the Secretary of State be requested to put such information in a tabular form, and prepare it and the reports in one document, for printing, for the use of the legislature.

Resolved, That the Secretary of State be requested to communicate the foregoing resolution to the Presidents of the several Railroad companies in this State. By order. H. N. Wales, *Clerk.*

State of New York, Secretary's office. I certify the above to be a true copy from the original on file in this office.

(Signed,) S. Young, *Secretary of State.*

The proceedings of the Railroad Convention lately held at Albany, are deserving of notice in the pages of this Journal, as showing a design to ac-

commodate the public by frequent trains and low fares. An attentive examination will show no spirit or disposition to anything improper

At a meeting of Delegates from the several Railroad companies between the Hudson river and Buffalo, held at the American hotel at Albany, on the 31st day of January, 1843, pursuant to notice, H. B. Gibson was apointed president, and Charles Stebbins, secretary.

The following Delegates appeared, viz:

Attica and Buffalo—H. Hawkins, V. R. Hawkins, J. P. Veeder.

Tonawanda—H. J. Redfield, Jona. Child.

Auburn and Rochester—H. B. Gibson, J. Fellows, D. S. Skaatts, Chas. Seymour, Robert Higham.

Auburn and Syracuse—G. B. Throop, T. Y. Howe, Jr., E. Williams.

Syracuse and Utica—J. Wilkinson, Holmes Hutchinson, A. Burt, C. Stebbins.

Utica and Schenectady—E. Corning, L. Benedict, W. C. Young.

Mohawk and Hudson—S. Stevens.

Troy and Schenectady—R. P. Hart, and B. Marshall.

Resolved, That Mr. Weld of Boston, be invited to attend this convention as an honorary member.

Resolved, That a committee of one from each delegation be appointed by such delegations to report upon the subjects to be acted upon by this convention and that such committee report at 3 o'clock, P. M.

The following committee were appointed, H. Hawkins, J. Child, H. B. Gibson, T. Y. Howe, J. Wilkinson, L. Benedict, S. Stevens, R. P. Hart.

The following resolutions were reported by the committee and adopted by the convention.

1. *Resolved*, That it is expedient to run the daily lines between Buffalo and the Hudson river connecting with the morning and night boats on the Hudson river out of Albany and Troy and that each line be run in 25 hours, including stops and that the same be apportioned as follows:

Buffalo to Rochester 6 hours—Rochester to Auburn 6 hours—Auburn to Syracuse 2 hours—Syracuse to Utica 4 hours—Utica to Albany and Troy 7 hours—25 hours; and that the time of starting from each end of the road for the two trains be as follows:

Buffalo	6 A. M.	Albany and Troy,	6 A. M.
"	4 P. M.	Schenectady,	8 A. M.
		Albany and Troy,	7 P. M.
		Schenectady,	9 P. M.

2. *Resolved*, That passengers ought to be allowed to pay their fare and direct their baggage to such places upon the route as they may deem proper, and that the superintendent of the several roads be directed to devise and execute a system to carry out this resolution under the executive committees of their roads.

3. *Resolved*, That baggage masters be employed at the joint expense of the several companies between Albany and Buffalo, to accompany each train and ticket and take charge of baggage between those points, who shall be paid by each company in proportion to their length and amount of receipts, and that the details of the plan to carry out this arrangement be referred to the superintendents of the several roads.

4. *Resolved*, That it is expedient that the car houses on the line between the Hudson river and Buffalo, inclusive, should be closed, and the passengers relieved from the press and inconvenience of being crowded, in the several car houses by persons who may resort there from curiosity.

5. *Resolved*, That it is expedient that a third run be made between the Hudson river and Buffalo, leaving the Hudson river at 10 o'clock P. M., and Buffalo at 12, noon, at uniform prices of 2½ cents per mile for one description of cars, and 1½ cents per mile for emigrant cars, and that it be referred to the superintendents of the several roads, under the direction of the executive committees, to arrange the arrivals and departures at the intermediate points on the line, and other matters in connection therewith.

6. *Resolved*, That the superintendents of the several companies, under the direction of the executive committees, devise and carry into effect a system of taking fare through the line, each way, for all the trains, of conveying and ticketing baggage, and such system for securing the emigrant travel as may be necessary.

7. *Resolved*, That a committee of one from each company be appointed by the delegates now present, to consider and digest a plan of stocking the passenger, baggage and freight cars, on the line between Albany and Rochester; and ultimately, when the line is completed, to Buffalo; and report the same to their several companies for consideration.

8. *Resolved*, That during the winter months, the train shall leave Buffalo at 7, A. M., and reach and remain over at Syracuse; and leave Albany at 9, A. M., and stay over night at Auburn; so that the passage between Albany and Buffalo may be made in two days, and that it be referred to the superintendents of the several roads, under the direction of the executive committees, to carry this out, and this to take effect on Monday, the 6th February instant.

9. *Resolved*, That a copy of the proceedings of this meeting be furnished to each company.

10. *Resolved*, That the two first lines commence on the 15th of March next, and the third line on the opening of the canal.

11. *Resolved*, That the several companies should be responsible to each other for all money received by their respective receivers, who are severally appointed by such companies.

12. *Resolved*, That the several companies upon the railroad line will not employ persons in the business of transportation who ever drink intoxicating liquors.

13. *Resolved*, That this convention deprecate the practice of employing runners at a distance from the respective railroads as destructive to the interests of the stockholders and vexatious to the travelling public, and that so far as in our power, we will use our influence against any company who shall hereafter employ any runner or agent at any other place than on the line of the road, at or near their depot.

14. *Resolved*, That the superintendents of the several roads be specially charged with the duty of giving extensive circulation by publication as may be deemed necessary, of the times of running such train and the prices between Albany and Buffalo, through the United States, at the expense of the several companies, in proportion to their length and amount of receipts, and that the proceedings of this convention be published in the papers of this city.

The convention adjourned without day.

H. B. Gibson, *President*.

C. Stebbins, *Secretary*.

LEGISLATIVE INTERFERENCE WITH RAILROAD MANAGEMENT.

A bill relative to railroads, having been reported in the legislature of this State, which seems to us one of the most monstrous absurdities of the day,

we have thought proper to place upon record our sentiments, although we entertain no doubt as to the ultimate fate of the measure.

The report and bill seem to be founded upon petitions setting forth the suspicion of a hideous combination between certain railroads, to cheat the *people*, to play into each others hands, and finally, to do something dreadful —we do not exactly know what, but the report appears to apprehend the subversion of the State government.

The main points of the report are as follow:—All combinations of *natural persons* are suspicious; when the rights of others are to be, or *may be* injuriously affected, they are illegal.—Corporations are not exempt from the liabilities of individuals. Then follows an illustration, drawn from monied institutions, which would equally apply to temperance societies.—Moreover railroad companies can give free rides to Editors, Judges and Legislators, and so bribe them. The use of motive power, etc., belonging to one company, on the road of another, forms a "union of strength and power which cannot be controlled, and is beyond the reach of every legitimate power known to the government." The gullability of the travelling public, is such, that they may be induced to purchase tickets for a road over which they do not desire to travel. Passengers may be "*seduced*" even from the decks of canal boats.

To obviate all these evils, the bill proposes to enact, that the fare prepaid for any road may be demanded back within 20 minutes after arriving at the end of the previous road; that whenever two roads unite, in all cases, a stop of 30 minutes must be made; that equal facilities (?) be granted by every railroad between the Hudson river and lake Erie, to every other railroad, for the purpose of procuring, carrying and transporting passengers, etc.; that there shall be admitted to the car house of each company two runners of any railroad, steamboat, packet boat or stage line; but that these runners shall not, under the penalty of a misdemeanor, solicit passengers!!! The bill further provides, that every car for passengers shall have glass windows —be lighted by night, and have "*comfortable cushioned seats with cushioned backs*"—that these cars shall always be run in the rear of every baggage, freight, or mail car. It finally provides that each company shall use none but its own cars, motive power, etc., under the penalty of $200.

Such are the provisions of the bill, which might be styled, a bill to interfere with railroad management—to incommode travellers—to patronise runners—to prevent the transportation of emigrants, and "to give every thing to every body."

Since our examination of this document, we have received the remonstrance against it by the companies on the line, from Schenectady to Buffalo. There is much good sense in this paper, and we give below, several passages which show the folly of any interference, although there are many points upon which we hardly think any argument need have been offered, unless to rebut absurd charges. We are averse from meddling with the politics of these matters, but we certainly hope that such proceedings may here-

after be rare, both for the safety and comfort of the travelling public, as well as for the credit of our State.

"The term monopoly has become of very general use and application, and is quite common in respect to railroads. When a measure, an improvement, or in short anything, is objected to because it is a monopoly, it may be well to consider whether its being so is a part of its nature, and essential to its continuance, or whether it can be divested of this feature and still be useful, available, or capable of existence.

It is the law, or a grant, that gives a monopoly character, if anything does. Now we suppose that no law can relieve a railroad in this respect, unless it destroys it. We doubt not, that all those who object to railroads, as monopolies, do not urge this because they wish all railroads destroyed, but from a want of reflection. The railway including its motive power, passage and freight property, is altogether a single machine or power; and it is as impossible for any foreign association or individual to come in and use it, as they or he please, as for two different sets of men to manage a steamboat at the same time, each resolved to go their own way. A single power and policy is necessary to control and operate a railway successfully.

To object to it therefore, because it is a monopoly, is either saying, that the individual making the proposition ought to come in and have his way upon it, and thus for the time be himself the monopolist, or that the thing itself should be abandoned because he cannot have what he conceives to be his share in the monopoly."

"The great bulk of the capital of railroad companies is invested in the road-bed and the tracks, where it remains incapable of transfer, and only productive by having the largest amount of business done over it. Several companies, upon the same line of railway, must necessarily manage in harmony; or the use of the line, to the public, is lost. This is so unlike the operation of moneyed or other corporations, that, to deduce the power, or the danger of their uniting *their* capitals, because the several companies upon the railroad line from the Hudson river to Buffalo, by acting in harmony, seek to make the passage in 25 hours, must be by a course of reasoning too attenuated for ordinary comprehension. To denominate the measures which railroad companies, upon a continuous line, must adopt as combinations, or confederacies, is such a misapplication of terms as want of knowledge, or the rival feelings of competing lines can only account for.

The application of such terms to this railroad line may be made with equal force against the arrangements from Albany to Boston, or to the New York and Erie railroad, or to the forwarding lines from Chicago to New York; in short, to every line of transportation through the country. Why can property be carried proportionably cheaper from New York to Chicago, than it can for short sections upon the same route? We suppose that it is entirely on account of the connected arrangement that is made."

"The railroad companies are under great responsibility in their business, for the proper care of the persons and property of their passengers, and they have found that to produce the largest accommodation they must adhere to rules, which may sometimes seem to be unfavorable to individuals, but which experience has shown are salutary. It requires skill, and a thorough knowledge of the business, to operate an important line of railroads."

"Although the bill alluded to does not propose to require the baggage to be overhauled at each termination, yet it contains provisions which may make that necessary in the most inconvenient manner. As the trains run day and night during the business season, some of them arrive at all the large towns

during the night, and at such arrivals very few of the passengers wish to leave the cars, and still fewer desire any arrangement that turns out their baggage or subjects them to the necessity of looking for it.

" It requires at all times great care to keep the baggage from being left or from going astray, and all the arrangements as to the baggage have for their first object security.

The large towns and all the lines of communication are known to be constantly infested with pickpockets and vicious persons who are continually depredating upon travellers, who would enjoy a harvest if at every arrival at a car house the baggage of passengers may be overhauled and they are to seek new seats. Suppose such a person in the train and he has his baggage put at the bottom of a wagon or car by design, and on his arrival at some convenient place he demands it; all the baggage must be taken out to find his, and in the mean time (for it will likely be night,) one or more trunks are stolen as he had designed should be the case. Usually it takes several cars to hold the baggage, generally not less than three; and if these are to be unloaded in the night in the presence of all who choose to mix with the passengers, it has been, as it always will be, found to be impossible to avoid difficulties resulting from accident or design. In all such cases travellers do not feel safe, for the reason that experience has shown that they are not so.

Suppose under the power which the bill professes to give him, that a pickpocket shall demand his baggage, and while searching for it that a trunk is stolen, (most likely by an accomplice,) shall the railroad companies bear the loss?"

" If the railroad companies are left free, as to the employment of runners or such agents, they will not employ them, but if they are to be licensed or recognised by law, as an appurtenant to the passage business, it would almost seem that all parties, in self defence, must employ them."

" A single suggestion as to a matter not strictly germain to the question involved, but brought in aid of the restrictions proposed in the bill, will close our memorial. It is urged that other competing lines, by a payment of tolls on passengers, are a source of revenue to the State. It would give the argument greater force if the State had not constructed, and did not keep in repair, the avenue in which their passage business is done. In short, if the State did not furnish the capital mainly for one mode of competition, and leave the other to individual contribution.

The railroad companies enjoy no immunity from taxation. The assessment rolls, the highway commissioners' lists, and the school district records in every town through which the railroads extend, will show how fully they share in the public burthens. It would be much to their interest to pay a toll on passengers equal to that paid upon the canal, and be exempted from other taxation. To impose a toll without such an exemption, would be perhaps more in the light of a bonus than otherwise.

In some towns the railroad companies pay a large share of the whole taxes, because a great amount of capital may have been expended there in cutting through ledges of barren rocks, or in crossing a deep morass. In some school districts they pay the largest part of the taxes for building houses and maintaining schools.

We entertain much confidence that the towns through which the railroads extend will not raise the objection that they pay less than their fair share of taxes.

RAILWAYS AND CANALS IN ENGLAND.

Herapath's Journal and Railroad Magazine, of 4th February last, contains " the railway and canal traffic returns of England, compiled from offi-

cial sources," in tabular form, and presents some facts highly interesting to the friends of internal improvement.

The number of railways completed and in operation in Great Britain, stated in the table, is 39, and their length, 1456 miles. The capital and loans authorized for their construction, is £55,576,976. The amount actually expended, is £52,290,024—equal to $261,450,120, or nearly $180,000 per mile.

All the main and long lines of railway, in England, without exception, pay dividends of from 1 to 10 per cent., keeping themselves in perfect order, with a "reserved fund" for this object. The short roads do not pay dividends in the same proportion. This is owing in a great measure, to their extravagant cost. The London and Greenwich railroad, 3¾ miles in length, cost $4,954,000, or $1,311,000 per mile, and divided 1¼ per cent. per annum.

The London and Blackwell railroad of the same length, cost £1,071,715, or $1,418,400 per mile, and divided the last year 2 per cent., on this immense outlay.

Name of Railway.	Miles.	Cost.	Cost per mile.	Value of Stock.	Dividends.
Great Western,	118½	£ 6,350,000	£54,529	93 per cent.	6 pr.ct.
Liverpool and Manchester,	31	1,438,654	46,408	192 "	10 "
London and Birmingham,	112½	5,832,254	51,842	212 "	10 "
Grand Junction,	97½	2,273,344	21,704	200 "	10 "
Stockton and Darlington,	43½	2,000,000	46,000	255 "	7½ "
Dublin and Kingston,	6	340,000	56,710	100 "	5 "
Manchester and Leeds,	6	2,913,000	57,120	100 "	5 "
	414	£21,147,252	£52,021 average.		

The cost of these roads is to be attributed, mainly, to the reduction of their grades to as near a level as the nature of the country traversed will permit. This rule is now to a great extent abandoned. The right of way, with legal and parliamentary expenses, also the embelishment to depot warehouses etc., are items of greater expense than in this country.

The seven railways above enumerated, yield the best returns. The other 32, costing £31,142,776, vary in their dividends, from 1 to 6 per cent., and are generally short roads.

It would appear that 414 miles of railway in Great Britain, has cost $250,000 per mile, or equal to three times the cost per mile of the 4000 miles of railroads completed in the United States. The average cost of the continuous line of 625 miles of railroad from Portland in Maine, to Buffalo or lake Erie, has cost within £6000, or $30,000 per mile. The average nett income on this line of 625 miles, may be safely stated at 7 per cent., although the Western railroad of Massachusetts, costing $7,565,791, for 156 miles of road, has only yielded the first year after its completion, about 4 per cent. The Utica and Schenectady railroad, and the Utica and Syracuse railroad, and the continuous line to Buffalo, has yielded from 7 to 12 per cent. nett.

The railway system in New England, may be considered eminently suc-

cessful, and is now a favorite investment, having the preference over bank stocks.

In England, the canals, from being a part of, and working in connection with railways and manufactories, have not been materially injured by the introduction of railways. It is true canal stocks have fallen much in value from what they were, prior to the introduction of railways. For *permanent investments*, the canals in connection with large manufactories and coaling districts, are in great repute, and have a value with their proprietors, much beyond their ratio of dividends. The Loughborough canal, gives 60 per cent. dividends, and is worth £1350 for £100 paid, or £94,500, for £10,000 paid out for its cost. The Trent and Mersey canal, that cost £130,000, yields 65 per cent. dividends and is worth £1000, for £100 paid.

It is stated that 36 canals—all the canals of Great Britain—cost £6,800,000. This is a sum not much exceeding the amount expended by the State of New York in canals, but with a very different result. This arrises from the scattered population in this State, compared with the dense population in the manufacturing districts of Great Britain, with the necessity of their use, to convey the raw materials of cotton etc., to the manufactories. This, added to the enormous amount of coal, iron, and various ores transported to the manufactories, and principally by those who own the canals, is the cause of their great value. It will take centuries to produce the like results in the United States. In the mean time, railways from their facilities in connecting distant districts and overcoming mountain barriers, are daily acquiring warm advocates, both in this country, and England. They have in fact, become indispensable for the transmission of our mails. They should merit the fostering care of the general government, instead of the abuse bestowed upon them by some incumbents of the heads of departments. For national defence, their value cannot be estimated or questioned.

J. E. B.

RAILWAY TRAFFIC.

The following calculation taken from the last weekly returns, of the first week in February, of 39 railways, in length 1456 miles, taken from Herapath's Journal and Railway Magazine, will be found highly interesting, when considered that the month of February in England, as well as this country, is not comparatively one of travel and traffic.

The number of passengers on 26 railways, was 233,551. The total for the week was about 500,000. The receipts on 39 railways, was £52,704, ditto for goods, £19,980, total, £72,684. This is an average of near £50 per mile per week. The traffic, therefore, is certainly at the rate of twenty-two millions of dollars per annum, and carrying twenty millions of passengers.

This practical view of the benefits of railways, in *gaining time*, and the transmission of a passenger, at five or six times the average speed of the stage coach, or canal, will make this class of improvement popular and indispensable.

J. E. B.

EXTRACTS FROM THE REPORT OF THE WESTERN RAILROAD.

The completion of this important work renders it necessary that we should record the principal information in regard to cost of construction—magnitude of the work, etc., as set forth in the report to the Massachusetts legislature.

The receipts and expenditures for the last year will be found in the table already given in our February number.

STATISTICS OF CONSTRUCTION.

The statistics required by law in the report, after the road is opened for use, are hereto subjoined, so far as they relate to its *construction.* And the undersigned add, also, in this connection, other data, which may prove useful or convenient for future reference.

The *length* of the Western railroad is as follows, viz: From its junction with the Boston and Worcester road, near the depot of this company, in Worcester, to the east abutment of the Connecticut river bridge, is

	Miles. Feet.		
	54.3680	or	54.697
From thence to the line of New York,	63.0568	"	63.107
Total,	117.4248	or	117.804
The length of the Albany and West Stockbridge road, from the State line to the face of the Greenbush dock at the Hudson river, is	38.1180	or	38.224
Total of both roads made by this company,	156.148	or	156.028
The length of the Worcester road from their passenger depot in Boston, to its junction with the Western, is	44.320	or	44.060
Total from the depot in Boston to the Hudson river,	200.468	or	200.089
Add from Greenbush dock to Albany shore,	1.415		268
Total from depot in Boston to ditto,	200.1883	or	200.357

ELEVATIONS.

For these, the *base line* of the Worcester company is assumed, it being the grade of that road, across the mill-dam basin in Boston, and the following are the elevations *above* that base line.

	Feet.
The depot of this company at Worcester,	476.83
The Charlton summit (between Worcester and Connecticut river,)	906.75
The depot at Springfield,	70.91
The summit in Washington (between the Connecticut and Hudson rivers,)	1,456.51
The track at the State line,	916.07
The summit in Canaan (between the State line and Greenbush,)	954.61
The depot in Greenbush,	26.11
Thus it appears, that the summit in Washington is the highest elevation of the road, and that this is above the depot at	
Worcester,	979.68
Springfield,	1,385.60
Greenbush,	1,430.40
and above the base line of the Worcester road, in Boston,	1,456.51

PLANES.

Upon the Western road there are separate planes 142, of which are

level,		12
ascending west,	83	
descending west,	47—130	

The grades of the road vary from level to 83 feet per mile. The apportionment is nearly as follows:

From 1 to 20 feet	33	miles.
21 to 45 "	44	"
46 to 60 "	11	"
68 to 83 "	14	"
Level,	7¼	"

Between 68 and 83, there is one plane of 5 to 6 miles of 74 feet grade, and 2 grades making over 4 miles of 79 feet.

The following table shows the number of curves, with the different radii in feet, and the lengths of the different classes in feet and miles:

TABLE OF CURVES ON THE WESTERN ROAD.

Number of Curves.	Length of Radii in Feet.	TOTAL LENGTH OF EACH CLASS In Feet.	In Miles.
25	22,920 to 5,730	39,887	7.5542
90	5,730 to 2,865	121,736	23.0509
59	2,865 to 1,910	72,651	13.7590
19	1,910 to 1,432	26,479	5.0333
17	1,432 to 1,042	26,054	4.9338
1	of 1042	1,500	0.2840
1	955	910	0.1723
1	882	490	0.0928
		289,707	54.8687
	length of straight (line,	332,297	62.9352
		622,004	117.8039

The shortest curves are severally of radii of 955 and 882 feet, and they are at each end of the Tuttle Bend bridge, on the north line of Russell.

The whole number of planes on the Albany road, is			82
Of which are level,		28	
Ascending west, (total ascent, 79½ feet,)	18		
Descending west, " 971 "	36—54—82		

The following table shows the inclinations in feet per mile, and the lengths of each class of gradients:

Number of Planes.	Inclinations in Feet per Mile.	Total length of each Class.
2	0 to 10	0.284 miles.
17	10 to 20	5.663 "
10	20 to 30	3.362 "
16	30 to 40	17.727 "
9	40 to 44.88	9.053 "
28	Level.	2.135 "
82		38.224 miles.

TABLE OF CURVES ON THE ALBANY ROAD.

Number of Curves.	Length of Radii in Feet.	Number of Curves.	Length of Radii in Feet.
20 of	6000 and upwards	10 of	3000 to 2000
11	6000 to 5000	13	2000 to 1000
5	5000 to 4000	1	859½
7	4000 to 3000		Total degrees of curvature, 1869.

Total curved line, 20.464 miles.
" straight line, 17.760 "
" 38.224 "

The whole length of main track laid on the Western road is	miles,	117.804
Length of turnout and depot tracks,	"	8.961
Total tracks laid on Western road,	"	126.765
The main track laid on the Albany road,	38.224	
Turnout and depot tracks, laid and in progress	5.750—	43.974
Total tracks laid by this company	miles,	170.739

A single track only has been laid down on both roads, with the necessary turnout and depot tracks at the stations.

On both roads, the edge rail of the T pattern, has been used (excepting on a few recent side tracks,) weighing 56½ pounds to the linear yard; supported by wooden sleepers, principally of chestnut, 7 feet long and 7 inches through, at distances of 3 feet from centre to centre. These sleepers rest on longitudinal sills of plank 8 inches by 3, with a short piece of the same 3 feet long, under them at their joints, and 4 additional pieces, 3 feet long, under the sleepers, at the joints of the iron rails. On a part of the Albany road, the sleepers nearest the joints of the iron rails are 2½ feet from centre to centre, with six instead of five sleepers to each rail; and the two sleepers nearest the centre of the iron rails have 2 short pieces, each 5 feet long, under them, to increase the bearing surface.

A small part of the turnout and depot tracks recently laid down on the Western road, and used only to deposit cars and trains upon, are of a lighter iron rail, purchased of the Lowell company, of the "*fish-belly*" pattern.

WIDTH OF GRADES.

The greater part of the Western road has been graded to a width of 20 feet in the cuts and 16 feet on the embankments, for a single track. The deep cuts and high embankments, generally, have been graded to a width of 30 ft in the cuts and 26 on the embankments, for a double track. The heaviest rock cuts are of double width; and the masonry is all for double track, except that of the Connecticut river bridge, and a few of the smallest structures.

The whole of the Albany road between Greenbush and Chatham, 23 miles, and a part of the remaining 15 miles, is graded for two tracks; the former, in the cuts, from 26 to 34 feet, and on the embankments, from 22 to 26; the latter 15 miles, in the cuts, 20 to 34 feet, and on the embankments, 16 to 26; and where graded for a single track, the earth cuts are from 20 to 24 feet, and the embankments from 16 to 20. The rock cuts, 26 feet wide, and the masonry, are all for two tracks. The portion of the road between Greenbush and Chatham was made of full width, with a view to its union with the New York and Albany road at or near the latter place, if that should be constructed.

BRIDGES.

The railroad bridges east of Connecticut river, are constructed of truss frames, after the plan of Long's patent, and are made for two tracks. The Connecticut river bridge, and those westward of it, on the Western road, are of truss frames, of Howe's more recent patent, and they are constructed for one track only. The truss frames of all are covered in on the sides and top, and thoroughly white-washed. The entire flooring of the Connecticut river bridge is covered with tin, painted of a dark color. This bridge is 1264 feet long, of 7 spans, 180 feet each.

The whole length of wooden superstructure of bridges is 6,092.5 feet, or 1 mile 812.5 feet and they are in number 48, both exclusive of road bridges over the railroad.

There are on the Albany road 17 wooden railroad bridges, including the 2 of 160 feet at the Greenbush and Albany landings; total length, 1,474 feet; 14 are for a single track only. The whole are built after Howe's plan, and the truss frames are covered in and white-washed.

There are on the Western road 10 stone arched river bridges, severally of spans of 35, 15, 45, 60, 60, 60, 45, 20, 45 and 45 feet, the grades of which, above the water, are severally 40, 12, 35.8, 49, 61.7, 67, 61, 39, 42, 28.8 feet. In addition, there are 2 stone arch bridges over highways, the grade at one of which is 52 feet above the highway, and 2 similar highway bridges over the railroad.

On the Albany road, besides 15 arched culverts of less than 10 feet span, there are two arched bridges from 10 to 20 feet span, two of from 20 to 30 feet span, and one of 34 feet, composed of 2 spans of 15 feet each, and a pier of 4 feet.

At Canaan, on this road, and about 3 miles west of the State line, is a *tunnel*, through limestone and slate rock, the grade in which is 100 feet under the surface at the highest point. It is 548 feet long, exclusive of the thorough rock cuts at each end, 26 feet wide and 19 feet high; the sides and arch being exclusively of the natural rock. It contained 9,920 yards of rock, and its excavation cost about $35,000.

The following is an *approximate* statement of the quantity of materials excavated in the construction of both roads.

	Earth Cubic Yards.	Loose Rock. Cubic Yards.	Solid Rock. Cubic Yards.	Total. Cubic Yards.
Western road,	6,156,117	81,396	543,600	6,781,113
Albany road,	1,553,423	19,177	227,395	1,799,995
Total, yards,	7,709,540	100,573	770,995	8,581,108

The quantity of masonry on the Western road, in perches of 25 cubic feet each, is about	220,586
On the Albany road,	49,968
Total on both roads	270,554

On the Albany road and depots there have been driven 3855 piles.

For the road-way, on both roads, the least *width of land* taken, except for a short distance in the village of Worcester, is 5 rods, and this has been increased, even in one case, to 18½ rods, where required for deep cuts or high embankments, allowing a *berm*, on each side, of 8 feet, for ditches and fences.

The whole quantity of land in the road-way thus located, between Worcester and the line of New York, and for the Western road, as *approximately* estimated, is 1,267 acres 73 rods.

The same for the Albany road is	381 "	78 "
Total,	1,648 "	151 "

With few exceptions, comparatively, the title has been obtained by purchase and deeds, and the claims for lands for road-way are all settled and paid off, with the exception of one on the Western and two on the Albany road, which have been unavoidably delayed, but are in progress. There are, on the Western road, 23 depots, comprising about 54 acres of land; and on the Albany road, 6 depots, containing, at present, 64 acres,—21 of which are at the Greenbush station, making, on both roads, 29 depots, with about 118 acres of land.

FINANCIAL DEPARTMENT.

The accounts for the construction of the Western road, and for the equipment of the whole line, are so far completed as to enable the undersigned to present the following:

Statement of the cost of the Western Railroad, to January 1st, 1843, with an estimate for future expenditures.

ITEMS OF EXPENDITURE.	Amount of estimates of January, 1841.	Amount paid January 1, 1843.	Amount expended or contracted for, and unpaid.	Total paid or contracted for.	Amount estimated for future additions.	Total for ultimate entire cost.
Graduation and road-bed,	2,181,746 67	2,269,983 17	12,394 74	2,282,377 91	7,000 00	2,289,377 91
Masonry exclusive of Connecticut river bridge,	639,301 42	724,158 91	1.633 07	725,791 98	3,000 00	728,791 98
Superstructure,	998,200 33	1,010,628 28		1,010,628 28	5,000 00	1,015,628 28
Connecticut river bridge and masonry of ditto,		131,612 12		131,612 12		131,612 12
Other bridging exclusive of masonry,	213,671 19	108,738 03	1,819 60	110,557 63	7,000 00	117,557 63
Depot buildings, fixtures, aqueducts, etc.	123,250 71	157,431 42	7,929 25	165,360 67	23,300 00	188,660 67
Land damages for road-way,	173,440 31	175,523 33		175,523 33		175,523 33
Depot lands,	10,585 27	16,361 49		16,361 49	5.000 00	21,361 49
Engineer department, instruments, etc.,	167,594 93	190,248 86		190,248 86		190,248 86
Miscellaneous expenses,	67,334 37	74,205 21		74,205 21		74,205 21
Engines and cars,	450,000 00	467,427 04	102,620 00	570,047 04	72,500 00	642,547 04
Interest,	209,900 67	*205,822 43		205,822 43		205,822 43
Extraordinary expenses of renting the Hudson road as a substitute for a part of the Albany road.		33,470 57		33,470 57		33,470 57
Totals,	5,235,025 87	5,565,610 86	126,396 66	5,692,007 52	122,800 00	5,814,807 52
* Interest paid to January 1, 1843,		555,263 13				
Less net income to same date,		349,440 70				
		205,822 43				

The entire cost of the Western road as now stated, exceeds the estimates made therefor by the engineer and agent, in January, 1841, by the sum of $579,781 65.

This excess occurs principally in the items of graduation, masonry, bridging, depot buildings and engines and cars. In the absence of that engineer, the undersigned proceed to state the causes of this excess, as fully as they are able, from the information at their command.

The extra cost of the graduation and masonry is caused by an omission in the estimate of 1841, to include an early payment to a contractor, who had abandoned a section, and a misapprehension of the division engineer, of the contract price of one of the heavy rock

sections,—by extraordinary disbursements authorized by the board in order to open the western part of the road before the winter of 1842—by improvements and alterations made by the road-masters after the road was opened,—properly chargeable to construction,—by the necessity of greatly increased expenses, in raising the original grade in the mountain division, to protect the road-bed against the freshets of an impetuous stream, and by grading and masonry, more recently required by the business of the road for additional depot and turnout tracks, and depot accommodations.

The last cause has also operated to increase the *superstructure* account.

The excess in the cost of *bridging* arises from work not originally contemplated,—such as *tinning* the whole flooring of the Connecticut river bridge,—placing, for greater security, 3000 perch of rubble stone about the piers; and the cost of extra timber for an entire span of that structure, to be housed and kept on hand for future use, in case of any casualty requiring it. And a similar supply of timber for renewing suddenly the superstructure of any other bridge on the road, together with recent expenses of strengthening the bridges between Springfield and Pittsfield. To these is now added a small estimate for future contingencies.

The large excess in the account for depot buildings is almost entirely caused by increased accommodations at the various depots, and by the addition of new ones, shown to be indispensable to the increasing business of the road; and by an estimate for future contingencies of the same character. The principal details of these have been hereinbefore stated.

The same causes have operated to increase the cost of depot lands.

The cause for the great excess of about $192,000 for the items of engines and cars, has been already fully explained.

In connection with this subject, it may not be irrelevant to add, that such was the character of many parts of the line, and particularly of the mountain division, that it was impracticable even for an experienced engineer to estimate before-hand, the cost of construction, with reasonable accuracy.

The 7th or mountain division, of 13.89 miles, has cost $980,000, or over $70,000 per mile. A single mile of that division cost $219,929 87. The summit section in Washington 1.8 miles long, cost about $241,312 39, or per mile, $134,000. It had in it 97,000 cubic yards of rock excavation, much of it very hard.

About 1100 feet of the embankment in the Richmond swamp, settled below the natural surface from 75 to 90 feet, as estimated; and that section alone contained 241,800 cubic yards of excavation, and it cost about $110,000. The single structure of the Connecticut river bridge cost $131,612 12.

The construction accounts of the Albany and West Stockbridge railroad are not so fully closed. The last division of that road was opened, only in September last, and the final measurements and estimates of a part of it, are but just now made out. The contracts for the very extended works at the Greenbush depot, are, some of them, still outstanding. The resident engineer, however, presents the following, as an approximate statement of the cost of this road, with an estimate for future additions and payments.

Statement of the cost of the Albany and West Stockbridge Railroad, to January 1st, 1843, with an estimate for future expenditures.

ITEMS OF EXPENDITURE.	Amount of estimates of January, 1841.	Amount paid January 1, 1843.	Amount expended or contracted for, and unpaid.	Total paid or contracted for.	Amount estimated for future additions.	Total for ultimate entire cost.
Grading, bridging and masonry, including Greenbush depot,	646,099 00	761,381 75	93,400 00	854,781 75	10,000 00	864,781 75
Superstructure,	380,783 00	287,609 21	16,600 00	304,209 21	4,000 00	308,209 21
Depot buildings, fixtures, aqueducts, etc.,	28,511 00	87,158 55	52,500 00	139,658 55	20,500 00	160,158 55
Land damages,	83,985 00	91,180 15	550 00	91,730 15	1,554 77	93,284 92
Depot lands,	41,154 00	30,547 18		30,547 18	9,000 00	39,547 18
Fencing,	36,447 00	25,054 16	7,500 00	32,554 16		32,554 16
Engineering, superintendence, instruments, etc.,	40,825 00	49,721 65	5,000 00	54,721 65		54,721 65
Miscellaneous expenses and contingencies,	20,000 00	17,056 56	9,000 00	26,056 56		26,056 56
Interest,	70,000 00	100,994 81		100,994 81		100,994 81
Part payment to Hudson company for right to build partly on their road-bed,		36,000 00		36,000 00		36,000 00
Payments to original stockholders for their preliminary expenses,		18,136 58		18,136 58	—	18,136 58
Steam ferry boat and fixtures, etc., for ditto, in Albany.	65,000 00	16,738 68	800 00	17,538 68		17,538 68
Totals,	1,412,804 00	1,521,579 28	185,350 00	1,706,929 28	45,054 77	1,751,984 05
Add the same for the Western road,	5,235,025 87	5,565,610 86	126,396 66	5,692,007 52	122,800 00	5,814,807 52
Totals, both roads,	6,647,829 87	7,087,190 14	311,746 66	7,398,936 80	167,854 77	7,566,791 57

The entire cost of the Albany road, as above stated, exceeds the estimate of January 1841, by $339,180 05; and this excess has arisen *entirely* from payments and expenditures for work not included in the original estimates.

As has been before represented, the whole character of the depot arrangements at Greenbush has been changed by authority of the board; and the whole accommodations, including lands, buildings, fixtures, docks, and bridges, have necessarily been very much enlarged.

In the summer of 1841, while the grading between Greenbush and Chatham was in progress, with a view to its completion early the following summer, the board, having resolved to push the work on the last division of the Western road, so as to open it for use during that year, gave directions also, to expedite this work and lay down the track so as to run the trains through between Worcester and Greenbush, before the winter should close in. This caused a heavy expenditure.

It was found also, in the progress of all the work on the line, through extensive clay and slate rock districts, that the security of the road required much more enlarged excavations and embankments than had been contemplated.

The preceding tables show that for the completion and full equipment of both roads, and for future additions deemed necessary, the expenditure will be $7,566,791 57.

But it should be borne in mind that there are sinking funds, provided for both roads and set apart to aid in the final liquidation of the debts incurred in their construction.

The amount of these on the 1st of January, 1843, was for the

Western road,		$177,529 58
Albany,	about	107,000 00
Total,		$284,529 58

And, although this is not available for present purposes, it is proper to consider it as *assets* of the company, in comparing the value of the work with its cost.

Several errors having crept into the paper on Dr. Earle's process, in our January number, we give it a second insertion, with some additional matter.

To the Editor of the Railroad Journal.

Philadelphia, February 22d, 1843.

Sir,—The following documents and testimonials explain themselves; and it is presumed, cannot be read without producing a strong conviction of the value and importance of the "Process" to which they relate. I beg the favor of an insertion of them in the Railroad Journal, and am, very respectfully, your ob'dt. servant, Edw. Earle.

Ordnance office, Washington, 12th Jan., 1843.

Hon. J. C. Spencer, *Secretary of War.*

Sir,—I have to acknowledge the receipt of a letter from the Hon. R. H. Bayard, of the United States Senate, requesting to be informed of "the result of any experiments that may have been made under the auspices of the Department, in relation to Dr. Edward Earle's method of preserving timber and cordage; together with the opinion of the department, or of any of its officers, as to its practical value,"—the same being referred to this office for a report.

The great cost of gun carriages, and the difficulty of obtaining suitable timber for their construction, induced this office, early in 1840, to consider

whether the interests of the service could not be promoted by the adoption of measures to prevent their decay. "Kyanizing," and "Dr. Earle's process," were both duly considered, and the great expense of the former led to the use of the latter, by authority of the Secretary of War. Since the summer of 1840, about 70,000 cubic feet of timber have been cured at the Watervliet Arsenal, the greater part of which is deposited in store for future use. The exact cost of the operation cannot be stated; but it is believed to be about* cents per cubic foot, and one and a half cents for the use of the patent right.

Sufficient time has not yet elapsed to prove the value of the process by the trials of gun carriages in service; but during the period of operations, the person charged with the supervising the curing of the timber (Mr. R. M. Bouton,) has made some experiments, which are set forth in a printed paper published by Dr. Earle, which is hereto appended.

Mr. Bouton is a man possessed of much more science than is usually found in such a first rate practical mechanic, and full reliance may be placed in his statements.

Upon a careful examination, of the subject, which its importance to this office, in a pecuniary view at least, seemed to demand, I have formed the opinion—

1st. That the impregnation of timber with the sulphates of iron and copper may be effected by its immersion in a proper solution of those minerals at a moderate heat, and with timber of any size or length.

2d. That timber, thus cured, will be in a great measure incorruptible, free from the attacks of worms, and from dry rot.

3d. That its strength is not reduced, and its toughness or fibrous texture is improved.

4th. That the cheapness of the process, united to its beneficial effects, promises a great reduction in the expenditures for such objects as are susceptible to its use, among which canvass and cordage seem to occupy a prominent place; and finally,

That this process will furnish the desideratum for the preservation of many things to which it is applicable, and should be patronized by the government.

I have the honor to be, Sir, very respectfully, your ob'dt. serv't.

G. Talcott, *Lt. Col. Ordnance.*

(INDORSEMENT BY THE HON. SECRETARY OF THE NAVY.)

Navy Department, Jan. 17th, 1843.

"I unhesitatingly express my full concurrence in the opinion and recommendation of Col. Talcott within given. I have no doubt that Dr. Earle's process might be advantageously applied to a great variety of materials used in the Naval service, and that the saving to the country would be incalculably greater than the cost. I therefore strongly recommend the adoption of Dr. Earle's process upon such terms as may be considered fair and just between him and the country.

"A. P. Upshur."

Navy Yard, Washington, 5th Jan., 1843.

Sir,—Agreeably to your order of to-day, I have tested the relative strength of the two pieces of rope received from Dr. Earle, being, according to his representation, different portions of the same rope; one being pre-

* The cost is here omitted because the several items constituting it could not be separately ascertained. According to Mr. Bouton's Report, however, it does not exceed 3 1-3 cents per cubic foot, and this may be confidently affirmed very much to exceed what is necessary, when the operation is advantageously conducted. E. E.

pared, according to his process, with the sulphates of iron and copper, the other unprepared; and find the result to be as follows:

The unprepared piece sustained a weight of only 71 pounds (average,) and the prepared that of 133 pounds; making a difference of 62 pounds in their relative strength.*

Very respectfully, your ob'dt. serv't.

ALFRED TAYLOR, *Lieut.*

CAPT. B. KENNON, *Com'dt.*

Dr. Earle may make any use of this paper he chooses.

B. KENNON, *Captain, Washington Navy Yard.*

Office of the Baltimore and Susquehanna Railroad Company,
February 6th, 1843.

DEAR SIR,—Having been absent from the city, I did not receive your favor of the 3d inst. until Saturday.

It gives me pleasure, now, to state the substance of the reports made to me by the superintendent, and by the machinist of this company; the statements of whom may be relied on with confidence. I only regret that the shortness of the period, during which we have been making use of Dr. Earle's process, does not enable us to speak with as much certainty of its effect in preserving timber as I could desire.

1. We commenced the use of Dr. Earle's plan on the 3d April last.

2. The largest piece of timber to which his process has been applied, was one of yellow pine, 25 feet long and 13 by 10 inches in width and thickness. This was used for a turn-table, and, in framing, it became necessary to notch each piece half way through, near the centre. It appeared to be well saturated with the solution, judging from the deposite of copper on the tools, and from the wetness of the wood, which had been seasoned before being placed in the vat.

About seven months since, the superintendent took two stakes made of a piece of white pine board, one inch thick. One of these he placed in the vat with some timber preparing for the road. They were subsequently both stuck in wet earth. The stake that was *Earlized* is now perfectly sound; the other evidently decaying.

From these circumstances it may, I think, fairly be inferred, that Dr. Earle's process will have a considerable effect in preserving timber from decay; but we have not had sufficient experience to justify us in pronouncing our opinion, as to the extent to which this effect will be produced. We are continuing to subject all the timber used in repairs of our road, to the treatment recommended by him.

With much respect, yours, very truly,

CHAS. HOWARD, *Pres't.*

GEN. JNO. S. SMITH, *Washington.*

From the Civil Engineer and Architect's Journal.

CONCRETE, ITS INTRODUCTION, COMPOSITION, USES, & COMPARATIVE EXPENSE.

Concrete was first used in this country by Sir Robert Smirke, at the erection of the Penitentiary at Millbank, afterwards at the undersetting of the walls of the New Custom House, and has been generally used by the above named architect in the public buildings since erected under his care, especially at the club house of the Oxford and Cambridge University in Pall Mall, where the whole area of the building, and to the extent of two feet beyond the line of the lowest footing, was covered to a depth of $2\frac{1}{2}$ feet,

* The strength being tried by applying the strain to each individual yarn.

the depth being increased to 4 feet under all the walls that rise to the roof; in the specification of the last named building it is thus described. "For the grouted stratum clean river gravel is to be provided, and mixed with lime ground or pounded to a fine powder; it is to be well mixed with the gravel, twice turned over before it is wheeled to the excavation, and it is to be thrown from a height of not less than 6 feet in every part. A man to be kept treading down and puddling the mass as it is thrown down; the proportion of materials to be 6 parts of gravel to one of Dorking, Merstham, or Haling stone lime." It has now become, in the present day, the most favorable expedient resorted to for artificial foundations. Mr. Ranger, of Brighton, improved the above hint by using hot water to facilitate the setting, for which he took out a patent for making artificial stone. A detailed account of the application of Mr. Ranger's artificial stone to the building of docks and river walls at Chatham and Woolwich, is given in the first volume of the *Journal*, being a paper by Lieut. Denison, from the Papers of the Corps of Royal Engineers. Analogous to concrete is beton, from which it differs, in broken stone being used instead of gravel, in the proportion of two of stone to one of lime or pozzolana of Itally, a description of which, taken from the *Franklin Journal*, appeared in volume 3, page 265, of your valuable periodical. Since the introduction of concrete, some little difference of opinion as to the proportion of materials and manner of mixing them has arisen among engineers. I therefore give the composition from several specifications: No. 1. The concrete to consist of 5 parts of clean gravel, perfectly freed from loam or clay, with a proper proportion of small gravel and sand, as well as large, and one part of lime measured dry, the lime to be mixed into a perfectly smooth uniform paste, as for the mortar, but with more water, and then thoroughly mixed with gravel. No. 2. The concrete to be composed of sandy gravel and well burnt lime, in the proportion of 3 of the former to 1 of the latter. The gravel to be free from all earthy matter, and the pebbles not to exceed one inch in diameter. The lime is to be used in a hot state when slacked, and to be immediately mixed, using no more water than is sufficient to incorporate them. After being twice turned, it is to be wheeled on to a stage 10 feet high, and let fall into the trench; it is not to be puddled or disturbed in any way until perfectly set. No. 3. All concrete must be composed of gravel perfectly clean, and mixed with fresh well burnt lime in the proportion of 6 of gravel to 1 of lime. The lime and gravel to be mixed in a dry state, and a sufficient quantity of water afterwards added. No. 4. Concrete to be composed of good lime, gravel, and sand, in the proportion of $\frac{1}{7}$ to $\frac{1}{9}$ of lime, and it should be laid in about 12 inch layers or courses, and pitched from a height of 10 to 12 feet, neither should it be disturbed until properly concreted and set.

In the above five opinions, including that of Sir Robert Smirke, we have the relative proportions of gravel and lime, varying from 3 to 9; and No. 1 states the lime and water to be first mixed, in which No. 2 nearly coincides, while No. 3 insists on the gravel and lime being first mixed, and then the water added; Nos. 4 and 2 coincide that the concrete is not to be disturbed after it is thrown into the trench, while Sir Robert Smirke expressly states that parties are to be employed puddling the mass. The whole are agreed in specifying that the material is to be thrown from a height. From considerable practice and experience in the mixing of concrete, I think that the lime need not be ground, but simply mixed with the gravel, and then, by the addition of water, it will fall to an impalpable powder, also that it is unnecessary to be at the expense of puddling the mass after being deposited in the trenches, neither is there any advantage to be derived from discharging the

mixture from a height, both of which operations increase the expense of the concrete, and as the concrete in the act of setting expands in bulk, I think that alone a sufficient proof of the inutility of both of the above mentioned operations, their tendency being to condense the mass, while its own natural tendency is to expand. With respect to the proportion of lime and gravel, I think the less lime the better will be the concrete, and that the proportion of 8 to 1 of lime is decidedly better than 3 of gravel to 1 of lime. As to the quality of materials employed, the lime must be stone lime, fresh from the kiln; that from chalk will not do, and hydraulic or lias lime is to be preferred to stone limes. With respect to gravel, if obtained from a pit, the ochereous or ferruginous is to be preferred, and if loam is present, so as to soil the hand, the gravel must be washed, if the gravel be obtained from rivers by dredging, alluvial and vegetable deposits are to be avoided; and if the gravel contain vegetable refuse, it must be screened or washed. Shelly sharp gravel is the best, the proportion of small or large pebbles, and the due quantity of sand, is soon learned with a little practice.

As to the uses of concrete, it is principally adopted as an artificial foundation, and from four to six feet is a sufficient depth, and extending two feet beyond the space to be occupied with the building. The following testimony of the utility of concrete, is from Weale's bridges, page 31. "Piling will probably never be found more safe than a body of concrete; the latter cannot be too much esteemed, for its durable and almost imperishable nature, besides being quite as safe and, perhaps, more durable than piling;" and from the paper of Lieut. Denison, before alluded to, we have the following ratification of its uses. "Concrete cannot be advantageously employed as a building material." "It may be employed with advantage in backing retaining walls." I. K. Brunel, Esq., C. E., has used concrete as a foundation, nearly exclusively and universally in the bridges on the Great Western railway; and in the celebrated bridge of Maidenhead, the land arches are backed with concrete. In culverts underneath embankments, the same able engineer has extensively used concrete as a backing material, the brickwork being kept thin, and then enveloped in a mass of concrete, in the form of a polygon, of six sides, or, of the form of two truncated cones, with their bases joined.

Concrete was used on the Great Western railway, wherever it could be employed, as a backing material; its use is now rapidly extending to the provinces, and bids fair to supersede all other means now employed for making a foundation; it is much improved by being mixed with oxide of iron, smith's scales, and roasted iron stone, or any material containing iron. As regards the comparative expense, brickwork being the most common building material, has been taken as the standard of comparison with concrete for price, and its cost in most districts will be found from one-third to one-sixth the price of brickwork, taking a cubic yard as the quantity of each material, the latter will cost 5*s.* and the former 21*s.* both, to a great extent, being regulated by the vicinity of brickyards, and the facility of obtaining gravel. I have known concrete executed at 3*s.* 3*d.*, 3*s.* 6*d.*, 4*s.*, 4*s.* 6*d.*, 5*s.*, 7*s.* 6*d.*, 8*s.* 6*d.*, and 11*s.* 6*d.* per cubic yard, although the most common price is 7*s.* 6*d.*; as to brickwork, the general price is 21*s.*, and the range is from 14*s.* to 27*s.* 6*d.* per cubic yard. The London price being 25*s.* per cent. dearer than the country. The facility of obtaining lime regulates the cost of concrete; the price of lime per cubic yard, measured dry in clots, at Dorking in Surrey, is 11*s.*; Barrow in Leicestershire 21*s.*; Bulwell in Nottinghamshire 9*s.* 6*d.*; Breadon in Derbyshire 15*s.* 6*d.*; Harefield in Buckinghamshire 16*s.* 6*d.*; Fulwell, Durham county, 9*s.* The measures of

lime, also, vary much; in some places it is sold by the cubic yard, measured dry, which is decidedly the best method adopted; it would be desirable if it was universal. It used to be sold in London by the hundred, as it was called, not of weight, but a measure, a yard square, and a yard and one inch deep, which will be equal to 16 or 18 bushels, but it is now sold by the cubic yard. The Fulwell and Barrow lime is sold by the quarter, eight of which make a ton and a half. Lime is also sold by the boll and chaldron; a chaldron will be about 3½ tons, a single horse cart about 6 bolls. In agricultural districts, the bushel, boll and quarter are used; in colliery districts, the chaldron and ton are the standard of measure. With respect to the cost of gravel, provided it can be obtained on ground belonging to the company, the getting, screening, and cartage will cost 1*s*. 6*d*. to 2*s*. per cubic yard; if it be obtained from the gravel pits of the country, the charge will be per ton, from 2*s*. 6*d*. to 2*s*. 9*d*., if screened 3*s*. 3*d*. to 3*s*. 10*d*., if broken 6*s*. 10*d*. A cubic yard will weigh from 24 to 27 cwt. If the gravel is dredged or brought from the shores of a river, the cost will be 2*s*. 6*d*. per yard, or nearly the same as from the pit. The prices of the various operations of getting, screening, and washing gravel are respectively 10*d*. and 12*d*. per cubic yard. The price of excavation is also included in the price of concrete in all railway specifications, which will be about 4*d*. per cubic yard, as generally the excavation is of limited extent, and consequently more expensive than an extensive excavation, and when the gravel is obtained on the ground of the company or proprietor, the excavation is a double operation, the hole having to be refilled with other materials in lieu of the gravel obtained. From the experience of several thousands of yards and variety of situations, I find the cost of mixing the materials, or as it is termed concreting, to be 1*s*. per cubic yard, and taking the proportion of material at 5 to 1, the following will be a fair estimate of the cost of concrete:—

		s.	*d.*
1 cubic yard of lime,		12	6
5 do. of gravel at 2*s*. 6*d*.,		12	6
Labor mixing at 1*s*. per yard,		6	0
6 yards of excavation at 4*d*.,		2	0
Waste, contingencies and profit, at 1*s*.,		6	0
6 cubic yards, at 6*s*. 6*d*.,	=	39	0

Concrete will set in 24 hours; the specific gravity is 125, or about the same as brickwork, although brickwork is sometimes 165 lb. per cubic foot. Lieutenant Denison gives the strength of concrete $S = \frac{lW}{4bd^2}$. The constant S being 9·5, and comparing concrete to York paving, the proportion is as 1 to 13.

The following works may be consulted; Colonel Pasley, on Calcareous Cement: Weale, 1839; Aikin, on do., in Transactions of Society of Arts; Lieutenant Denison's Notes on Concrete, from papers of Corps of Royal engineers, *Journal*, volume 1, p. 380; Lieutenant Colonel Ried, ditto, see also, the *Journal*, volume 1, p. 134; a letter on concrete, by a Constant Reader, volume 3, p. 265, volume 5, p. 58, 276.

I am, etc., O. T.

St. Ann's, Newcastle-upon-Tyne.

For the Railroad Journal and Mechanics' Magazine.

PRODUCE AND MERCHANDIZE DIVERTED TO BOSTON BY "LOW FARES."

By an official report to the legislature of Massachusetts under oath, we derive some facts that may be interesting to us.

It appears that the whole number of way and through passengers, passing over the Albany and West Stockbridge railroad and Western railroad, 156 miles, to the Boston and Worcester railroad, was 190,436.

The number of miles run by the merchandize cars, was		160,089
Equal to single trips, *through* 156 miles,		1,026
The weight of the merchandize carried over the road, was equal to 6,211,971 tons *nett*, transported one mile only. Or, equal to, carried over the whole road, 156 miles,	tons,	39,820
This, for 1026 trips, gives per trip,	"	$38\frac{3}{4}$

The average tonnage per trip is very much below the ordinary capacity of the freight engines, and much below what would be desirable for a profitable freighting business.

The report then goes on to state :—" as a striking evidence of the excess of business turned East, it may be stated, in reference to the business of the Greenbush station, opposite Albany, that during the last year there were

sent from that place eastward 170,715 bbls. flour,	tons,	18,615	
And other merchandize,	"	12,374	—30,715
The amount received at Greenbush from the East, for the last year, was	"		5,624
Difference,	"		25,091
The amount *through* from Albany to Boston, was	"	14,128	
Amount through from Boston to Albany,	"	2,472	
Difference,			11,656

The directors make the remark :—" It ought to be borne in mind, that, at the commencement of the year, the road had but been partially opened to the Hudson river, giving an access to a community, before that time, almost secluded from an eastern market. The business sought for, had long been accustomed to other and desirable channels of communication, and to other and *larger markets.* The last year has been therefore, emphatically one of experiment,—a year for ascertaining the difficulties of the trade in which we have embarked, and for gaining a knowledge of the means by which the difficulties might be obviated for the future. We virtually had no experience to guide us, in fixing upon tariffs of charges, *that would command the traffic, etc.* Notwithstanding these embarrassments, the undersigned look upon the past year as one of signal success."

Let us regard the subject in view of the low rate of 32 cents for a barrel of flour from Albany to Boston.

They took over their road 170,615 barrels, or	tons,	18,341	
There was taken from Albany in merchandize, beef, pork, etc.	"	12,374	—30,688
The whole tonnage carried over the road,			39,820
Difference, all the business of New England,	"		9,132

It would appear that three-fourths of the freight business over the Western railroad, was from the mouth of the Erie canal, while 16,560 tons, (principally flour,) was distributed on the line of the road. There were about 240,000 bbls. of western flour sent by schooners, and through New York to Boston. A reduction of fare to 25 cents per bbl., as contemplated, will command this freight, while they can afford to take sugar, molasses, and bulky articles, by the return trains, *at half the rates* we now charge by our tow boats on the North river. We argue this to be the case, as we perceive the *through* freight going east, is 30,688 tons,—compared with 5624 tons transported west. That they will profit by the " last year's experience," and "*so regulate their charges as to command the traffic,*" to a considerable ex-

tent, there can be no question. They have $7,050,000 embarked in the Western railroad to Albany. Boston owns half the railroad stock on the line from Albany to Buffalo. She has, with the citizens of New York, $30,000,000 of capital advantageously invested in railways, yielding a nett profit exceeding 6 per cent. per annum. The capitalists of the city of New York have expended about $10,000,000 in the way of improvements, and cannot put their finger on a single railroad enterprize that yields her a dividend. They have all been ill judged, while she leaves the line to Albany, through a fertile and rich country, to linger, when it has been repeatedly demonstrated, by repeated examinations, and estimates uncontradicted, that this road will pay a better income than any railroad in the United States.

J. E. B.

CIRCULAR

From the committee appointed by the National Institute for the promotion of Science, in June, 1842, consisting of—

Hon. John. C. Spencer, Secretary of War, chairman.
Hon. Lewis F. Linn. U. S. Senator, Missouri.
Hon. Wm. C. Preston, U. S. Senator, South Carolina.
Hon. Jos. R. Ingersoll, House of Representatives, Philadelphia, Pa.
Hon. Abbott Lawrence, Boston Mass.

Washington, February 24, 1843.

To the friends and correspondents of the National Institute and the members of scientific and learned societies of the United States, etc., etc.

On the 15th of October last a circular was addressed to the scientific and literary men of the United States, transmitting a copy of certain proceedings of the National Institute for the promotion of science, and inviting particular attention to that portion of the proceedings which contemplated the general meeting proposed by the Institute to be held at the seat of government.

The circular was at first attempted to be sent directly to individuals, but it was soon found impracticable to address all who were entitled to special invitation. The members of the institute, and those who had, in various ways most liberally contributed to the promotion of its objects, were of course expected to attend; yet the difficulty of obtaining all the names and residences of others, eminent in the various branches of knowledge, rendered it necessary to resort to a more general mode of effecting the purpose. With this view the circular was published in the papers of the District of Columbia, and was thus made general.

The object of the first circular was not to fix any particular time for the meeting, nor was it intended by the Institute or the committee to make Washington the place of all subsequent meetings, if it should appear to be contrary to the judgement of those who had the right to decide upon such an important question. It was rather to obtain preliminary views of the friends of the Institute, and general information as to the time and mode of convening; and afterwards to adopt a plan and a time (which might be gathered from the replies of those whose opinions had been solicited) to be the most convenient.

These replies have been numerous and interesting, and present almost without exception a decided approbation of the step that has been recommended, as well as of the course of the Institute under the auspices of which that step has been begun. The committee, after having carefully considered these replies, have come to the conclusion that the month of April, 1844, is the period which will best suit the convenience of all.

The committee were aware that several previous attempts had been made to get up a similar meeting upon the plan of the British Association, and that those attempts had proved fruitless. Perhaps too much was expected at a time when our learned men were unprepared for co-operation in such extended plans. But the idea had found favor, and it may be affirmed justly that we owe, in no small degree, to the system of State geological surveys the present improved prospect of accomplishing a noble and long-cherished object.

Under these circumstances, about three years ago, some of the gentlemen engaged in the New York survey (the fruits of which are already beginning to appear in published volumes, reflecting honor upon the liberality of the State and credit upon the abilities of those who have been engaged in the enterprise) proposed to bring about the object by a different method. Circulars were sent by them to geologists of other State surveys, and a meeting was held in Philadelphia in 1840. This meeting was respectable, and resulted in the formation of the "Association of American Geologists." It adjourned and met again in Philadelphia in 1841. At the second meeting it was deemed expedient to adopt the foreign plan of changing the place of meeting. Boston was chosen as the place for the third meeting, at which its objects were extended, and the association became the "Association of American Geologists and Naturalists." The fourth meeting is to be held in Albany during the month of April, 1843.

The proceedings of this association had been witnessed by the National Institute with feelings of deep interest; and in 1841 a formal invitation was sent from the latter to the former, requesting them to make Washington the place of one of the annual meetings. The invitation was promptly accepted, and it has been decided that the fifth meeting of the "Association of American Geologists and Naturalists" is to be held in Washington in the month of April, 1844.

The disadvantages and inconvenience of two meetings have, after mature reflection, appeared to the committee so obvious, that they have thought it best to fix the first Monday of April, 1844, as the period for the general meeting; and they take this occasion and mode of respectfully inviting to Washington, in the name of the National Institute, the members of the American Philosophical Society, the oldest scientific institution of our country, the members of the Association of American Geologists and Naturalists, and the members of all other scientific and learned societies in the United States, the honorary and corresponding members and friends and patrons of the Institute, and all others engaged and concerned in the "increase and diffusion of knowledge among men."

The plan of operations will be left entirely to those who may be present on the occasion; the Institute and the committee, without attempting to control them in any manner, charge themselves with the duties of making every preparation in their power, adapted to facilitate the scientific objects the promotion of which such a body may be supposed to cherish.

The following report of a minority of the committee on Internal Improvement of the North Carolina legislature contains an excellent answer to some widely current and fallacious opinions in regard to railroads etc. The report of the majority is embodied in the one now published, and we therefore give only the latter. It also contains useful information upon the public works of North Carolina, and will well repay the perusal.

EXTRACTS FROM THE REPORT OF THE MINORITY OF THE COMMITTEE ON INTERNAL IMPROVEMENTS, SUBMITTED TO THE LEGISLATURE OF NORTH CAROLINA.

The minority of the committee on Internal Improvement, have read, with regret, the report of the majority of the committee, on so much of the Governor's message as relates to the subject of internal improvement. The scope and tendency of the report, if not so designed, is to render odious, the message in relation to this subject, to draw into discredit and disrepute the works of internal improvement already established in the State, and to prejudice the public mind against all and every improvement, which may be now contemplated or hereafter devised. To accomplish this purpose, the majority report from carelessness or inadvertence, has assumed facts and hazarded assertions, many of which are altogether groundless, and utterly unauthorized as the minority will now attempt to demonstrate. The report commences with a concise review of the various recommendations in relation to Internal Improvement, contained in the Governor's message, and then proceeds with the following assertion: "The legislature has from time to time granted away to associated wealth, in the shape of corporations, the rivers of North Carolina, and now the people cannot carry a boat load to market, without paying tribute money to navigation corporations." Is this true? The slightest inquiry or the least investigation would have satisfied the majority, that this assertion is entirely without foundation. The principal rivers of the State, are the Roanoke, Chowan, Cape Fear, Neuse, Pasquotank, Tar, Cashie and Trent, on not one of which except Cape Fear, is a cent of toll levied, or authorized to be levied on the transportation of produce below the Falls thereof and but one of them above the Falls, to wit, the Roanoke, where the navigation has been opened and improved at an expense of four hundred thousand dollars by a joint stock company, created by acts of the general assemblies of North Carolina and Virginia. The report of the majority proceeds and asserts, that "the legislature has, from time to time, granted in like manner, exclusive privileges to railroad companies, until they have been stimulated to begin such enterprises; and after exhausting their own means, these railroad companies have procured the credit of the State, and finally involved the people in a debt of more than a million of dollars; though, in the outset, the capitalists who asked for the charters professed to ask nothing but the right of spending their own money for these works. Had they proved profitable, the people at large would enjoy no right but the benefit of paying tribute to these corporations, for carrying them or their produce from home to a market; but, so soon as they proved to be a losing concern, by little and little, the loss must probably fall upon the State treasury. The State had little or no chance of the profit, yet the State is to bear the loss." A more uncandid, disingenuous and incorrect paragraph, has been rarely, if ever witnessed in any paper whatever, and more especially, one emanating from an important committee, appointed to consider subjects deeply interesting to the people of the State. The first assertion in the paragraph, is "that the legislature has from time to time granted in like manner, exclusive privileges to railroad companies." Has any exclusive privilege been granted to railroad companies as asserted, or has any individual, or set of individuals, by the acts of assembly incorporating such companies, been deprived of any privilege previously enjoyed? None whatever. The leading privilege granted to these companies, is to transport on their roads persons and produce at a moderate rate of compensation, and for this purpose, to become common carriers in their corporate capacity. Is any individual, or set of individuals, who may choose to associate together, prohibited from carrying persons and produce whithersoever he or they may please? Are

not persons daily and hourly thus employed in every direction and in every part of the State? No one is bound or obliged to use railroads or avail himself of their advantages, unless at his will and pleasure free and untrammelled. The former mode of transportation of persons and products by stages and wagons or private conveyance, is left free and unincumbered, and none need resort to railroads unless they find their interest promoted by doing so. Certain it is, that unless this mode of transportation by railroads is cheaper and better than the former method, they will not be employed, and that they are so employed, affords the most conclusive and satisfactory evidence of the great benefits and advantages resulting from this mode of conveyance. The report of the majority proceeds: "And after exhausting their own means, these railroad companies have procured the credit of the State, and finally involved the people in a debt of more than a million of dollars; though, in the outset, the capitalists who asked for the charter, professed to ask nothing but the right of spending their own money for these works." The fact is notorious, and it ought to have been, if it is not, within the knowledge of the majority, that the people at present are not involved in a debt of more than one million of dollars for the railroad companies, or indeed, for any other sum.

It is true, the Wilmington and Raleigh railroad company, have obtained the credit of the State as security, for two hundred and fifty thousand dollars for which liability, the State has the most abundant and ample security. To secure the State against loss, a mortgage has been executed, under authority of law, on the railroad, the construction of which cost between one million five hundred thousand and two millions of dollars, and whose annual income under the present disastrous and discouraging state of things, after paying all the ordinary expenses of the road, amounts to about sixty thousand dollars. Nor is this all. The mortgage also includes all the property of the company, consisting of steamboats, engines, cars, coaches, lots, wharves, warehouses and depots, worth at a low estimate, independent of the railroad, at least fifty per cent. more than, and perhaps double the amount for which the State is security. It is then absolutely certain, that the State can sustain no loss on this account, unless through the most unwise and blundering legislation. Let us now see how the matter stands in relation to the State liability for the Raleigh and Gaston railroad company.

Under an act of the general assembly passed at the session of 1838, the public treasurer was authorized in his official character, to endorse the bonds of the Raleigh and Gaston railroad company, to the amount of five hundred thousand dollars, by which the State became security for that sum. To secure the State against loss, a mortgage was made by the company, which cost more than a million and a half of dollars, and this was considered at the time, and is now deemed to be ample indemnity. But the State has other and additional security. At the session of 1840, the legislature agreed that the bonds of the company should be endorsed by the public treasurer for the further sum of three hundred thousand dollars, provided the stockholders of the company would give their individual bonds, with good security, to secure the State against loss for the five hundred thousand dollars endorsed by the State in 1838 as before related, and another mortgage on their railroad and all the other property of the company; which condition has been strictly complied with, as we are informed by the governor in his annual message to the general assembly. It will thus be seen, that although the State is security for the Raleigh and Gaston railroad company, for the sum of eight hundred thousand dollars, yet, to indemnify and save harmless the State, a mortgage has been executed for the whole of the railroad and

other property of the company, which cost about double this sum, and the State has the further security of the bonds of individuals with good security for five hundred thousand dollars. With what justice and propriety can it, then, be asserted that the people are involved in a debt for the railroads, amounting to more than one million of dollars? In reference to so much of the majority report as declares that when the stockholders of the railroad companies asked for the charters, they professed to ask for nothing but the right of spending their own money for these works, there is surely some misapprehension, at least in relation to the stockholders in the Wilmington and Raleigh railroad company; for although no aid was granted by the State to effect the work at the time the first charter was granted, the stockholders always looked to the State for assistance, by way of subscription to the stock of the company, which was obtained at the session of 1836. Again says the majority report: "Had they (the railroads,) proved profitable, the people at large would enjoy no right but the benefit of paying tribute to these corporations, for carrying them or their produce from home to a market; but as soon as they proved to be a losing concern, by little and little, the loss must probably fall upon the State treasury. The State had little or no chance of the profit, as long as there was any hope of profit, yet the State is to bear the loss." This is another glaring example of disingenuousness, for which the majority report is particularly remarkable. If the State contributes nothing towards the construction of railroads, and those works are effected at the expense of individuals, what other benefit can the people or State who contribute nothing to the works, expect to derive from them, other than to have their persons and produce transported to market at a moderate rate? He that sows not, neither shall he reap. And upon what principle of equity or justice, can those, who stand aloof and husband their resources, unwilling to aid in accomplishing a great public work of acknowledged utility expect to derive profit from the same in the shape of annual income?

In proportion to the interest which the State has taken in the railroads, (and only in one of them has she any direct interest,) she enjoys an equal chance of profit, in proportion to her subscription, as other stockholders—and more than this she cannot expect. In regard to the other railroad—if the work had turned out to be a profitable investment, the State having subscribed nothing to construct the road, could rightfully expect no profit, except the general benefits and advantages resulting from cheaper and more expeditious transportation to market. Whether the loss of making the railroads in this State is likely to fall upon the State treasury, has been already abundantly disproved. The majority report further sets forth, that "your committee have good reason to apprehend that the same beginning of turnpikes, by corporation charters, will terminate in a similar way to North Carolina. Indeed, your committee greatly misapprehend the message referred to them, if it does not shadow forth this very unusual second step in their charters, when it is recommended to give these turnpikes such aid, etc., as the condition of the public treasury may justify." Suppose, for the sake of argument, it should turn out that the money expended for the construction of the railroads in this State is a bad investment of capital, which the minority of the committee hope presently to prove is directly otherwise, does it necessarily follow, that turnpike roads, the utility and advantages of which have been tested and experienced by every State in the Union, north of this State, nor any other project of internal improvement, is ever to be again attempted within our borders? Hopeless, indeed, would be the condition of our Western brethren, who are, unquestionably, as much entitled to the fostering care of the legislature as any other portion of the people in the State,

if this is to be the fixed and settled policy for our future government. It is a policy, wholly and absolutely opposed to the enlightened age in which we live—the present advancement in civilization and improvement of the civilized world—and utterly inconsistent with the prosperity and happiness of the people of the State. If the principles of the majority report are to govern the future policy and destiny of the State, most degraded and miserable will be the condition of her people, in comparison with those of other States. With resources uncrippled, and an energy unsubdued, North Carolina will, in a few years, become the byeword of reproach and contumely throughout the length and breadth of our extended country. But a few years ago, and there was scarcely an enlightened and liberal man in the State who was opposed to a judicious system of internal improvement. What great and monstrous error has been committed on this subject within this State? What foolish, wasteful, and extravagant expenditure of public money has occurred to reduce and lower the tone of public sentiment in relation to internal improvement? The minority of the committee know of none whatever; and if the public feeling has undergone any material change on this subject, it must be referred to other and different causes. It is the misfortune of the age in which we live, that every thing, however useful and valuable, no way connected with federal politics, must be mixed up with the wretched party squabbles of the day, and nothing, however important to the welfare of the State, is allowed to escape this miserable contamination. And, in this regard, it is a melancholly reflection, that we are daily growing worse and worse. It was not the case a few short years ago, and the people must rouse up and cast off the fatal error, or there is too much cause to apprehend the most disastrous results. The necessity of judicious works of internal improvement has been long felt and acknowledged by the most enlightened and patriotic men of both the political parties which now divide the State. They have seen and felt this great necessity, and have, from time to time, urged upon the general assembly the adoption of needful measures to improve the condition of the State. If there be any thing erroneous or wrongful in this it is a wrong or an error common to both parties, and for which neither is alone responsible.

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The larger portion of the remainder of the majority report is devoted to building up a man of straw of their own creation, that they might have an opportunity of exhibiting their skill and dexterity in toppling it to the ground. Thus the majority assert, "that the treasury is in no condition to aid in the construction of turnpike roads, and that it is useless to investigate the value and cost of turnpikes across more than half the State, when it is known the State has no funds that can be applied in aid of their construction." "And furthermore, that the legislature ought not to tax the people, or borrow money for this purpose, if they could." Now all this flourish about taxing the people and borrowing money is entirely gratuitous. The message of the governor, contains no such recommendation, but on the contrary, it expressly advises the general assembly, "that whatever schemes of expenditure you may embark in, that you keep within the means at the command of the State; otherwise, the people must be taxed more heavily, or the State must contract a loan. The pressure of the times forbids the former; the tarnished honor of some of the States, should make us for the present, decline the latter." Although he has recommended that certain companies be incorporated to make turnpike roads, which are greatly needed to the west, and would most essentially promote the public welfare; yet the assistance, which he suggests may be given to such improvements at present, should be con-

fined to the means already set apart for internal improvement, and which under existing laws can be applied to no other object. These means consist of a cash balance on hand, and some bonds, which the majority states to amount to forty thousand dollars, and bonds given for the purchase of Cherokee lands, amounting to something less than three hundred thousand dollars; making the aggregate sum of about three hundred and forty thousand dollars. This fund, sooner or later, or a considerable portion of it, must be applied to the making of a turnpike road or roads to the west in aid of individual means and exertions, in some just proportion, perhaps on the two-fifths principle, or some other just ratio, between the State and individuals. A portion of these bonds applied towards the construction of turnpike roads in the western part of the State, when united with individual capital, would, like heaven-born charity, bless both giver and receiver. It would enable the obligees to these bonds, who gave more than double the value of the lands they purchased, to redeem them by the contribution of labor to make the roads, and at the same time, afford a fair return of profit in the shape of tolls on the investment. No time whatever, could be more propitious than the present to engage in such works, but for the fact, that in the present general distress and embarrassment, individuals could not now raise their portion of the means necessary to accomplish this desirable improvement; and therefore, for a time it must be postponed. The expenditure of two or three hundred thousand dollars in the Western portion of the State in the way suggested, where there is now existing an unexampled scarcity of money, would produce benefits, and be attended with advantageous results, which can hardly be described. But the minority have not time to enlarge upon them and must hasten to a conclusion.

It has been a matter of much mortification and surprise, to witness the senseless and inconsiderate clamor which has been raised against railroads, in almost every part of the State. They have been denounced as only calculated to benefit the rich, at the expense of the poor; that their construction has occasioned a heavy loss to the State, without any adequate return; and that, consequently, they deserve not the fostering care of the public. These charges and denunciations have been made and believed for the want of better information, and the minority will now undertake to disabuse the public mind from the deceptions and impositions under which it has labored. The first striking advantage resulting from railroads, is seen in the certainty and despatch with which persons and produce are conveyed on them. Persons travel on them at the rate of one hundred and fifty to two hundred miles in twelve hours, with as much safety as by any other mode of conveyance, and at a great saving of time and expense. The transportation of produce on them, although not quite so expeditious as the conveyance of persons, is yet five times more so than by wagons. This speedy transportation, always advantageous, is frequently of the utmost importance. A rise in the price of produce often takes place, which continues but for a short time, and it is very material that farmers and merchants should be in a situation to avail themselves of such a rise. A single example will sufficiently illustrate this advantage. During the last fall, the price of wheat in Petersburg opened at $1 12½ per bushel. In these times of low rates for all articles, this price was considered very good, and every one felt desirous of profiting by it, for it was forseen that it could continue but for a few weeks. A farmer and merchant in Granville, promptly availed himself of the railroad in his neighborhood, hastened his wheat to market, and obtained for it the price before mentioned; whereas, those who had to depend on the more tardy transportation by wagons, generally sold at but 75 cents per bushel. But a still more striking

and conclusive advantage, results from the great reduction effected in the expense of carrying produce to market. Previous to the construction of railroads in the neighborhood of the falls of Roanoke river, the price of wagoning cotton and other articles to Petersburg, was from 75 cents to $1 per hundred. The price now by railroads, is 25 cents per hundred, so that the saving to the grower of produce is, at the lowest estimate, twice as much as the freight per hundred on the railroad. Again, a merchant of much intelligence, in Raleigh, has furnished the minority with a statement, showing the rates formerly paid on the transportation of produce by wagons, to Petersburg, and the rates now paid by the railroad. From this statement it appears, that the price by wagons was from one to two dollars per hundred, the average being one dollar and fifty cents. The price now paid by the railroad for the same articles, is seventy cents, being a saving of more than one half of the former rate. By wagons, the price paid on salt was two dollars per sack; the price now paid by the railroad on the same article, is sixty-five cents, being a saving of double the amount now paid, by the railroad. The saving to the growers of produce, who send to market by the Wilmington and Raleigh railroad, has also been very great. These facts furnish some data on which to estimate the amount of saving to the agricultural interest in this State.

During the last year, the receipts on the Raleigh and Gaston railroad, amounted to, in round numbers,	$66,000	
Deduct one half of this sum, supposed to have been paid by passengers,	33,000	
And there will be left for freights on produce,		33,000
The receipts on the Wilmington and Raleigh railroad for the same time, amounted to,	230,000	
Allow one fifth part to have been received for freights on produce, is		46,000
The receipts on the Petersburg railroad, for the same period, were	174,000	
Supposing the receipts on produce on this road, sent from North Carolina, not included in the amount sent to that road from the Raleigh and Gaston road, to have been equal to one fourth of the whole receipts, and we have the sum of,		43,500
The receipts on the Portsmouth and Roanoke railroad, for the same time, were	70,000	
The portion collected for freights on produce from North Carolina, is estimated at one-fourth part, and will give the sum of,		17,500
The amount of freight then paid on produce from North Carolina, and supplies received in return, will be		140,000

The saving to the people by the cheaper transportation on railroads, is, as already shown, double the amount of freights, and the consequent saving per annum is two hundred and forty thousand dollars, and in two years and a half, is equal to the full subscription of six hundred thousand dollars, made by the State of North Carolina to the Wilmington and Raleigh railroad company. The minority of the committee cannot, nor do they venture to give the assurance, that the foregoing estimates are correct in all their parts; some may be too high, and others too low, but they have endeavored to approximate as near to accuracy as the information accessible to them allowed. Supposing, however, that the saving to the people by railroads should be

only one half the sum estimated, how much cause has the State, and those persons equally benefitted with stockholders, who have not shared in the heat and burden of the day, to be thankful for this great benefit, and how utterly groundless must be the vituperation and abuse which have been so lavishly heaped on railroads. So far from there being any just cause for this abuse, it is a fact undeniable by any candid man, that the people owe a debt of lasting gratitude to those spirited and enterprising citizens, who have effected such valuable improvements, in which rich and poor, according to the amount of their productions equally participate.

There is another important view of this subject, which seems to have been entirely overlooked or neglected. Even admitting that there may be no return of profit in the form of dividends on the capital invested in railroads, for some time to come, still this capital has not been lost to the State. Much the greater portion of it has been diffused and distributed more eqeally among the people, and has gone into the pockets of those who have furnished supplies of provisions, materials, and labor, for constructing the roads and still remains in ihe State, to benefit and bless hundreds and thousands.

The last part of the majority report remaining to be noticed, concerns so much of the governor's message as relates to an application to the general government to open a direct ship navigation between Albemarle sound and the ocean. If the recommendation contained in this part of the message should be adopted, the majority report seems to consider that the general assembly would place the State in the humble and degrading attitude of *begging* the general government for what it has not to give. Nothing can be more erroneous and unjust than this view of the subject. North Carolina asks nothing of the general government, but what she is authorized to demand as a matter of right. Thousands, hundreds of thousands, and millions of dollars, have been appropriated and expended in other States of the Union for similar objects, a large portion of which have, by no means, superior claims to the works proposed to be erected in this State. The State of North Carolina fully shares with her sister States in the burthens of the general government, and why should she not also participate equally with others in its benefits? But this subject has been so satisfactorily examined in a short report, by a member of the minority, whose constituents are more immediately interested, hereto annexed, that nothing further will now be added by the minority.

A. Joyner,
Jon. H. Jacocks,
Alfred Dockery.

AMERICAN MECHANICAL SKILL.

We find in the report of the Judges of the Twelfth Annual Exhibition of the Franklin Institute, several notices of mechanical skill, which are highly creditable to the exhibitors. From all the rest we have selected three which appeared most interesting.

The first is in reference to a theodolite constructed with a view to obviate by a simple contrivance, a disadvantage frequently noticed in the construction of the vernier—its success, however, we doubt, as the risk of inaccuracy appears to be considerable.

The clock spoken of, was presented at the American Institute fair in this city, and to us appeared one of the most original and ingenious contrivances in the whole exhibition. The award of the committee in this case was well bestowed.

The transit, by Mr. Wm. J. Young, also deserves notice as being new evidence of the competency of intelligent American mechanics to compete with the best workmanship, the world can produce.

No. 224, theodolite, made by Edmund Draper. This useful instrument presents a specimen of excellent work, and is of the most approved construction. The verniers are supported on a hinge, so as to rest on the graduated limb with little force, and to move over it with little friction, and thus to prevent the abrasion which is often observed.

No. 356, clock of a new construction, by A. D. Crane. The regulating power of this curious clock is neither a pendulum, nor a balance; but a globe of brass is hung to the end of a long flat steel wire, which, being twisted round in one direction, is untwisted by the weight of the globe and its own elasticity, and wound round in the opposite direction, and so on alternately. At each of these movements, an appendage at the upper end of the wire acts upon an escapement of a peculiar construction, so arranged as to be nearly frictionless, but of which it would be difficult to give an intelligible description in this report. Although this revolving pendulum is no longer than that of an ordinary mantel clock, each revolution of the globe occupies half a minute; so that the movement of the clock may be maintained for a much longer time than in those in which the escapement is acted upon every second or half second. Accordingly, the clock sent to the exhibition is said to be capable of going an entire year, without requiring to be wound up. The committee look upon this as a new and interesting instrument, and recommend it as worthy of the award of a silver medal.

No. 872, transit or meridian circle, made by Wm. J. Young. This remarkable instrument is a most successful example of the highest class of mechanical skill. It is an exact copy of a meridian circle made by Ertel and Sons, at Munich, and now at the High School observatory in Philadelphia. A description of it cannot be introduced into this report; but the committee have pleasure in expressing their belief that it is the most perfect, as well as the most difficult, work of the kind ever executed in this country, and, as such, they recommend that it have the award of a silver medal.

Cast Iron Buildings.—A correspondent of the Times says:—"Buildings of cast-iron are daily increasing, at a prodigious rate, in England, and it appears that houses are about to be constructed of this material. It is proposed that the walls shall be hollow, so that the whole house may be heated by a single stove in the kitchen. A three-story house, containing ten or twelve rooms, will only cost about £1000; and it may be taken to pieces, and removed to another place, at an expense of about £25. It is understood that a large number are about to be manufactured, to be sent to Hamburg, for those persons who have had their habitations burnt."—*London Athenæum.*

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AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 5, Vol. I. Third Series. | MAY, 1843. | Whole No. 424, Vol. XVI.

We are indebted to the Hon. Henry L. Ellsworth for a copy of the Patent Commissioners' report, and also for a copy of the correspondence between himself and Gen. Brisbane.

Also to Mr. Chas. L. Schlatter, for a copy of the Pennsylvania canal Commissioner's report; and likewise Mr. S.'s report on the Harrisburg and Pittsburg railroad.

LOW FARES.

The evidence of the successful operation of the system of low fares, comes in upon us daily. The trial has been made on both sides of the Atlantic with equally satisfactory results. In this country, we find many of our main lines have given it a trial, and more recently the State of Pennsylvania has, from economical considerations, adopted the same system upon her public works.

It appears, however, that in the minds of some persons, a misapprehension exists as to what is meant by low fares. The term is entirely relative, and on no two roads could the same meaning be attached to it. There are two principles upon which the tariff of fares are regulated—the one is from the ascertained existing traffic to calculate the price necessary to repay the expenses and charge as much profit as it is thought can be obtained—the prices thus determined are called by way of distinction *high fares.*

The other principle takes into consideration the whole traffic, not only upon the road itself, but upon all parallel routes, whether steamboat, canal, or common road—and to ascertain the accommodations necessary to transport a fair proportion of the whole—the price is then regulated rather with a view to the cost of transportation for a full train than to the charge that individuals may be willing to pay, or in short, to divide the expense incurred among as many as possible, rather than among as few as possible. The prices thus determined are the low fares.

The first principle considers the travel as constant in amount, not to be increased nor encouraged, and takes no cognisance of competing lines. The second principle of course depends upon diametrically opposite views—looks upon travel as capable of being created and invited, and regards the individ-

ual in his private conveyance as a competing line, which with all others of the same nature must be put down.

Among the most striking instances of the successful operation of low fares, we notice that of the Glasgow and Grenock railroad. This line is 22½ miles in length, and has to encounter an opposition on the Clyde from some of the finest steamers of Great Britain.

The receipts on this road for the six months ending 30th November, 1842, were	£24,248	
Expenses during the same period,	10,366	—13,882

or nearly $6000 per mile per annum profit.

The charge on this road, is 9*d* Sterling for the entire distance, say 18 cts. or 8 mills per mile.

From the character of the stock, this seems to be no extraordinary profit, it is therefore a fair criterion by which to judge of the workings of the system.

REPORT OF THE CANAL COMMISSIONERS OF PENNSYLVANIA, FOR 1842.

This document appears in a much less voluminous form than its predecessors did, and yet contains much matter of interest even to general readers. We shall endeavor to present an outline of its most important features, condensed into as small a space as possible.

The general depression of trade is said to have been especially experienced at Philadelphia and Pittsburg—the two great termini of the State works, and accordingly the annual income is less than had been expected. It appears, however, that the receipts on western products going east have exceeded those of the preceding year, and that there has also been an increase of revenue upon the Delaware and North Branch canals.

In regard to the prospects of the ensuing year, the experiments during the last year with light draft steamboats on the Ohio, are cited as giving the assurance, that during the driest season and lowest water the navigation of that river can be depended upon as furnishing the means of supplying traffic to the canals.

Great expectations, however, are based upon the operation of the sectional portable boats. As far as we can gather from the report, it is intended that the State shall furnish the trucks, etc., for the transportation of these boats and thus encourage individual competition. The small cost of a boat when compared with the extensive capital necessary on the plan upon which the business was formerly conducted leads to the hope that a brisk competition will increase the amount of traffic upon the works—an end which frequent and liberal reductions of toll, have hitherto failed to accomplish, from the trade being exclusively in the hands of a few large companies.

The rivalry of the Baltimore and Ohio railroad, and the consequent diversion of travel from the Pennsylvania lines, are regarded by the commissioners as matters of serious importance and a sufficient inducement "to ex-

ert all proper means to cheapen the fare, and to reduce the expenses of travel" on their lines of improvement.

By an anomalous policy the State has hitherto furnished motive power and every thing else but the car while she has received less than half of the high fare charged. The expenditure of millions has thus been rendered almost profitless, while but a few thousand dollars were necessary to give her the control of prices, which at a much lower rate would yield a larger profit than they do at present. The extent of loss, by this policy and the manner in which the commissioners propose to obviate it, we give in their own words.

"The estimated and probable cost of the eighty-two miles of the Philadelphia and Columbia railroad, including engines, depots, machinery, stationary power, etc., is over four millions of dollars, while the entire cost to furnish all the cars for carrying the passengers is less than thirty thousand dollars. Notwithstanding this monstrous discrepance, the State, after furnishing the engines, fuel, stationary power, engines, firemen, agents, despatchers, hitchers, switch tenders, etc., has received less than one-half that has been charged upon the passengers travelling over that road. The fare upon each passenger to Columbia has been three dollars and twenty-five cents, of which the State has received only one dollar and sixty-four cents, the companies having received the balance. However strikingly disproportionate this may appear, we believe the disparity is still greater upon the Allegheny Portage railroad. On that section of our improvements, there is thirty-six miles of double track, ten inclined planes, two stationary engines at each plane, and the cost of keeping which in repair, including ropes, locomotives, horse-power, depots, engineers, agents, and men to work and keep up the road, renders it probably the most expensive railroad of its extent in the world; while the whole amount required to stock it with cars sufficient for all the travel that passes it, cannot exceed from four thousand to six thousand dollars. Yet, the price of fare charged on each passenger passing over it has been two dollars, of which the State receives as her proportion, only seventy-eight cents!

"To change the system of carrying passengers, and to approximate as nearly to that which should be adopted, if the passenger cars were owned by the State; and to get the power of limiting the assessments on passengers, and to effect a reduction in the rates of fare, were objects which the board deemed to be indispensable, in order to increase the travel upon our improvements, and to retain even that which we have already. And they are happy in being able to state, that they have made such arrangements, as will effectually change the system, and certainly produce a greater revenue, establish regular and uniform rates, and effect a great reduction in the price of fare upon all passengers travelling from city to city upon our canals and railroads.

"A contract has been made with responsible individuals to supply the cars and to carry passengers over the Philadelphia and Columbia railroad for

one year, at thirty-six cents for each through passenger, the contractors to be at the expense of all the depots, offices, collectors, clerks and agents to attend them; and they have entered into bonds in twenty thousand dollars, for the fulfilment of their contract.

"Arrangements are also in progress, by which it is expected to make still greater proportionate reductions in the price of fare upon the Allegheny Portage railroad, and at the same time to derive a greater amount of revenue from the passengers upon each of these roads than has ever before been received.

"By the plan contemplated, and the agreement entered into, it is stipulated and agreed, that the fare on through passengers shall be only two dollars on the Columbia railroad, one dollar on the Harrisburg and Lancaster railroad, and one dollar and twenty-five cents on the Allegheny Portage railroad, and that the charge in the aggregate upon each passenger, shall not exceed *ten dollars* from city to city. By such a reduction in the rates of fare from those paid during former years, we have every reason to anticipate a considerable increase of travel upon our improvements. But in any event, whether we have less or more, the terms and conditions of our arrangements are such that the State will derive hereafter a greater revenue from any given number of travellers that shall pass over her improvements, than she has ever before received."

It is expected by these changes, and by the reduction of expenditure, that the operations of the next year will prove still more profitable to the State.

The following abstract gives the receipts for one year and the expenses for nine months ending November 30th. The details of the operation of the Columbia road will be given in another place.

Lines. Main line from Philadelphia to Pittsburg, viz:	Tolls collected in 1842.	Expenditures and liabilities for nine mos. ending Nov. 30th, 1842.
Columbia railroad,	$357,461 50	132,499 45
Eastern and Juniata divisions,	195,780 16	45,072 12
Portage railroad,	124,258 40	96,528 63
Western division,	85,449 42	26,080 00
Total for main line,	762,949 48	300,180 20
Delaware division,	94,459 08	23 545 11
Susquehanna and North and West Branch divisions,	76,112 14	55,066 90
Beaver, Chenango and French Creek divisions,	6,692 99	11,254 49
	940,213 69	
Deduct drawbacks,	19,714 27	
Total receipts,	920,499 42	390,046 70
Deduct expenses for nine months,	390,046 70	
Excess of receipts over expenditures,	$530,452 72	

It is remarked that the expenses for the three months excluded from the table are materially less than for the navigable months of the year.

The completion of unfinished works is earnestly recommended, and in a special report, the loss to the State is estimated at nearly three millions of dollars, if the Erie extension is not finished—the amount necessary for that purpose being about $200,000. The importance of this line is very strongly insisted upon.

"The Engineer corps has been reduced to one principal Engineer"—Mr. C. L. Schlatter, of whose services the State has already made ample and satisfactory trial—and judging from the amount of professional labor necessary, we think that he will have enough to do.

"The subject of selling the surplus water on the several lines of our canals and slack-waters, has become important; and in the opinion of the canal commissioners, a prompt disposal of it at every place where it may be in demand, and where it can be used for machinery and milling purposes, will be alike advantageous to the State, and beneficial to the public.

"The erection of such establishments along the lines of our improvements will tend to stimulate enterprize, to develope the resources of the sections of the country where they may be located, and induce investments of capital, which while it gives employment to men in converting grain and other products into marketable articles, will, at the same time be the means of furnishing to our canals and railroads, a great additional amount of tonnage, from which the State will derive an increase of revenue from the use of her public works."

The report of Mr. J. B. Moorhead, superintendent of motive power on the Columbia railroad, furnishes some data of interest to those engaged in this species of improvement, and also furnishes the statistics of the road for part of 1842.

From this report, we learn that the rope, etc., for the Schuylkill inclined plane used during the year before, has been paid for this year; the stock on hand in the machine shops has to be added to this, and deducting the stock of fuel on hand from the preceding year, there remains a balance of $10,998 12 to be added to the nett profits.

There are now forty locomotive engines in the possession of the State beside three which are beyond repair or on sale as not suiting the purpose intended. The experience in regard to the use of coal, is worth recording in the language of Mr. Moorhead.

"Repeated attempts have been made to use anthracite coal as a fuel on this road; and with engines constructed in the form of the two last mentioned, (the boiler and tubes being placed in a vertical position over the fire,) the project would no doubt be successful; but it has been fully settled by experiment that a very heavy expenditure would be necessary to fit the engines now in use on the road for that purpose. Bituminous coal, however, has been used in considerable quantities during the last two years, and with en-

tire success. All the engines now on the road are using it to some extent, and I would recommend that at least double the quantity be used as soon as it can be obtained on the opening of the navigation next season. I am satisfied from my experience that a mixture of bituminous coal and wood is decidedly the cheapest fuel for this road. As wood becomes scarce, the proportion of coal can be increased, and if necessary, it can be used altogether, without any material alteration of the engines now in use."

The reduction of the tolls on heavy articles is recommended as this description of freight has been drawn off the road by the competition of other routes.

" *Expenses of maintenance of motive power on the Columbia railroad from March* 1*st*, 1842, *to November* 30*th*, 1842.

	Total amount.
Foreman, clerk and mechanics at Parkesburg shops	$11,339 74
Engineers of locomotive engines,	6,405 25
Firemen of " "	4,733 82
Despatcher, laborers, attachers, engineer and firemen of stationary engine at Schuylkill plane,	5,407 00
" Engineers, firemen and laborers on Schuylkill level,	2,549 12
Mechanics at repair shop, Schuylkill plane,	952 67
" " " Columbia,	1,317 31
Despatcher and laborers at "	2,237 49
State agents on passenger trains,	1,863 00
Watermen,	1,783 10
Horse power on Schuylkill level, at Schuylkill plane and at Columbia,	3,169 46
Superintendent and clerk,	1,986 50
Carrying, cording, moving and inspecting wood,	1,888 99
Water companies for water,	736 63
Sawing and splitting wood,	1,576 62
Oil,	3,104 84
Wood,	17,937 54
Materials for repairs of engines,	7,852 99
Miscellaneous, stationery and printing,	383 83
Repairs of engines done at manufacturing establishments,	452 74
Castings,	679 53
Coal,	4,035 00
Rope for inclined plane,	4,155 37
Ropes, etc., for engines,	203 22
	$86,762 48

SPARK AND SMOKE BURNING.

These nuisances to travellers are no source of profit to railroad companies, the amount of damages paid annually for accidents by fire, being no small item of expense, every fire within half a mile of a railroad being attributed to the sparks from locomotive engines, and as it is difficult to prove

an *alibi* for each spark, the mischief is pretty certain to be fathered upon those who are best able to pay for it.

The use of coal, which is some cases has been enforced by legislative acts, as free from these dangers and inconveniences, is not likely to mend the matter, as the wires of ordinary spark catchers are soon destroyed by the sulphur of bituminous coal, and the sparks which escape are more enduring and therefore more dangerous than those from wood. Anthracite for the use of which but few engines are intended, is the only fuel free from these objections.

A plan which has suggested itself seems to meet some of the difficulties of the case and we give it for what it is worth. The sparks and smoke are the result of imperfect combustion, and any means by which the combustion can be wholly or in part perfected, will in an equal degree, remove these defects. This imperfect combination is of course owing to an imperfect supply of air, and if more air is passed through the furnace the only effect is to increase the quantity of fuel in imperfect combustion. A supply of air in the smoke box is the only remedy, but if this air be cold, it will not finish the combustion, but by its cooling agency will diminish the evaporating power. It is therefore proposed to furnish a supply of pure and heated air to the smoke box. The modes of accomplishing this are various but would all of them be substantially the same. A pipe leading from the open air should pass through the furnace and boiler into the smoke box at its lower part. This end should be directed in such a manner as to prevent the accidental stoppage by cinders—the other should be furnished with a valve or register to regulate the supply of air. A contrivance of this kind must be more effectual if the air could be introduced at a higher temperature than could be attained by passing the pipe directly through the water. To accomplish this it would only be necessary to have one of the lower tubes of the boiler made some two or three times larger than the rest, and through this flue to pass the pipe for introducing the air. This pipe should be led around the sides or top of the furnace and terminate at some convenient place on the outside; it would thus be out of the way of injury in the furnace and give a larger heating surface. Two small pipes, one on each side, would be better than one large one—the heat would be greater and the arrangement more convenient.

It would cost little or nothing to make the trial, by simply fastening one or two pipes into the fire end of the boiler tubes and bringing the tubes through the furnace into the air, while the tubes of the boiler themselves, would temporarily at least, answer the purpose of the rest of the pipe.

Similar contrivances for smoke-burning have been very successfully applied to stationary engines, and it appears to us that the plan above suggested would be a suitable modification for the locomotive. It is at least worth a trial which would not cost more than the wire of a common spark catcher.

CONSTRUCTION OF RAILROADS ON THE PRINCIPLE OF ASSOCIATION.

Few persons are aware that a railroad is now in process of construction upon the principle of associated labor. We have frequently heard of it, but until lately no precise information has reached us upon this subject. We have now the pleasure of laying before our readers, the report of Gen. Brisbane, President and Engineer of the work, and also his correspondence with the Hon. Henry L. Ellsworth.

Although the principles of Gen. Brisbane are not universally received yet no one can fail to be pleased with his enthusiastic perseverance. That much good may be accomplished, and railroads constructed upon this plan where they otherwise would not have been attempted, no one can doubt. There are of course difficulties peculiar to this system, but how well and successfully they have been encountered by Gen. Brisbane, the reader will see for himself.

CORRESPONDENCE BETWEEN THE HON. H. L. ELLSWORTH & GEN. BRISBANE.

Patent Office, Dec. 8, 1842.

Sir:—I have noticed in the public papers with great pleasure your successful efforts in constructing a railroad without the use of much cash.

Will you permit me to request you to state to me the kind of road, and the manner you have accomplished this very desirable undertaking? In these hard times the community will, I think, be largely your debtor.

In the west, where the prairies are quite level, and the timber (oak) tall and straight, I have supposed associated labor might do something. Let me ask—

1. The cost per mile?
2. The practicability of using horses; and how far in your opinion wooden tracks will answer, without so much grading, as horse power only might be needed on them.

I want to learn the cheapest construction. The western States are so deeply involved that they can never complete their works begun, or connect some now finished in different places without adopting your plan; therefore all the information you can give me will be gladly received.

I beg you to accept my last report with the patent office regulations and patent laws. I add also a pamphlet on western improvements, which may interest you.

Accept the assurance of my high respect and best wishes.

H. L. Ellsworth.

Gen. A. H. Brisbane, Georgia.

Irwin County, Georgia, Feb. 11, 1843.

To the Hon. Henry L. Ellsworth—

My dear Sir—I was truly gratified on my return from the north to find your communication touching the improvements now covering our extensive country. I am satisfied that a general sympathy will contribute greatly to the common good. The experiment that we are making, and to which you particularly allude, is one which I trust will be attended with the best consequences, but I am desirous that its reputation should not antecede its real merits. For this reason your letter has been left unanswered so much longer than it should have been; for upon my return home many difficulties presented themselves, which threatened the most disastrous results; but the storm has now passed off, and without compromising any important feature of our plan of operations. To understand each other the more easily, al-

low me to premise that I divide labor into three distinct departments—*producing labor*, *transporting labor* and *exchanging labor*, and to a certain extent regard the laborers as of distinct classes. Each of these classes have had their separate modes of acting. The landlord interest is distinct from the farming—the farming from the day labor employed by it, the commercial capital furnished by the all puissant banker—the wholesale dealer—and the retailer, the transportation department, the corporate company, the contractor, and his immediate operatives. But these modes have, through the bias of our republican institutions, undergone sensible changes. For instance, no sooner does the agricultural emigrant reach your teeming West, than the two last functions, those of the farmer and day laborer, are merged in the one glorious privilege of freehold proprietorship. With the mercantile interest the case is somewhat similar. Communities organize proper fiscal agents, these are accessible to all and the wisest or wittiest is the surest to exact tribute of his poor fellow exchanger. In the transportation department above I found a degree of vassalage, which, as an engineer, I felt unworthy of the instruments I was compelled to make use of. Here we have the same uncompromising company—the same exacting contractor, o'erlabored wight. Where, in the agricultural interest, the farmer is stricken out, and in the mercantile the banker, so in the transportation I strike out the contractor, and instead of the laborer being a mere hireling, I make him the possessor of the road wrought on. He is placed at once on a footing with the freehold agriculturist and the mercantile capitalist. You now have the philosophy of my plan; let us now enter into the detail required by you. It must have been apparent to you that the hardy sons of Erin, the most athletic men on earth, and emphatically the great transportation class of this country, were selected by me to work out my plan. It is even wittily said that Ireland was intended by our all provident Creator as the grand nursery for all canal and railroad makers. However this may be, I resolved, whoever made these important works for me should own them, and in all my operations as engineer, have directed my attention to this very important result.

Circumstances made me sufficiently acquainted with a body of Irishmen equal to my experiment. But physical force without the aid of talent and capital, was unavailing. I am happy to say that my statement of the above proposition, and the adoption of the important connection between the Gulf of Mexico and the Atlantic, as my field of operations, secured the last two functions, and I have now constituted our transportation department within the State of Georgia, as distinct an element of the body economic, as either the agricultural or commercial. And why not, to adduce a single argument? If this class be not distinct, which of the other two should perform its duties? Not the agricultural surely? The seed-time and harvest are of too important a character, and succeed too rapidly, the one upon the other to allow this. The same objection holds with the merchant. The invoices and sales, with the thousand contingencies balancing these are well calculated to employ the entire attention of the exchanger. Hence neither of these can control the importunate interests of transportation. But, you may ask, can the delver, who works his two horses in the ditch, or in the trucks, even though he may own the fruit of his labor, be entrusted with the conduct of the work labored on? I answer, without the slightest doubt. Whether as actual agent of transportation, or simply as owner of the stock, no one is better calculated to judge of its value, or to care for its welfare, than he who has wrought for it, or who owns it as his all. Who, before this department was taken from the hands of the common wagoner or droger, managed its

interests? These people themselves, and the case is not altered, when a charter is made to cover their operations, or rather to combine them. So far my free labor principle has been confined to Irish laborers, as I have stated; but nothing could prevent your German emigrants from adopting it, save that they are required for the culture of your lands, and heaven knows Ireland is prolific enough of her millions to monopolize the entire land carriage upon my principle.

You next ask me of the character of our work. It is intended for a 30,000 bale crop, but as this may be increased to 100,000 bales in a few years, we graduate our road to 30 feet per mile, lay a wooden structure down equal to the thrust and tonnage of an engine power, and remain satisfied for the outset, to take one 30,000 bales to market with horse power, and over a wooden ribbon, instead of iron rail. Should the cotton increase threefold, the simple addition of iron upon the ribbon would be sufficient, without changing the power; but when it reaches beyond, the horses will be exchanged for steam.

I am satisfied that the tall oak timber of which you speak would suit this species of construction admirably. Let the logs be procured 32 feet long, 6 inches the width to which they should be reduced by hewing, and when hauled to the tracks, eight feet of the smaller end be taken off, and laid crossways at the distance of eight feet apart to sustain the remaining twenty-four feet, which will constitute the stringer upon which the ribbon, four inches square, is to be tressnailed to with pins, one inch thick. Instead of letting in the stringer upon the cross-tie, we bore a hole, two inch diameter, through them, and bind them with a wooden pin of the same size. This constitutes, with ties not less than a foot in diameter, a firm foundation for the ribbon, and when the iron rail is superadded, it cannot be better placed than upon the ribbon.

The cost of graduation is 15 cents per yard, and when the excavation is made upon a loamy soil $2 50 is easily made per day, as the laborer will displace from 15 to 17 yards. The task of a good axeman is eight pieces 32 feet long of good timber, hewed on two sides only, as this is all that is required, in fact it is only necessary to hew the face to be placed uppermost, and simply beat off that which is to lie upon the cross-tie, the points of bearing only being required to be callipered to a proper thickness that they may lie flush. The cost of the four-inch ribbon will be determined by your mills. The laying down of cross-ties and stringers we pay $5 per 100 feet for, to bring it to the same price with the excavation and embankment, and five men will complete 200 feet with ease in a day.

The ribboning can be tressnailed down at $1 50 per 100 when the work is done by experienced workmen.

Thus you will have all the data for determining your mills cost. It would be proper in your dense country to reduce the stock labor to $2 per day in all departments. Less than this will not satisfy the general run of laborers when cash payments are offered by different interests. You inquire the performance of the horse. I have as yet made no satisfactory calculation on this head as we were too late this year for its cotton crop, but a burthen equal to the utmost effort of the horse makes little impression upon the four inch rail. I would only observe here that when the latter was equal to the trade it would be equally so to employ steam. I am satisfied that in a new country the one should precede the other on the same track, of course, in time.

I have now answered your questions, or in round numbers, stated that $1,500 per mile for graduation, and $500 for superstructure, should cover the entire cost of the road.

1. That the grade of the road should not vary with the power to be used but turn solely upon the service to be performed, looking first to the use of the horse and then to steam.

2. I would not advise the commencement of a work upon the stock labor principle, upon less than 25 per cent. of the estimated cost of the work furnished in *cash*, and this will be required to cover the expenses of food, clothing, tools, wagoning, etc.

3. And lastly, to organize the force, that two years should suffice to accomplish the entire work, for any period longer than this exhausts the confidence of the operatives.

4. I read with great interest your paper on the subject of western settlement. We have purchased a large district of land through which our road passes, and we propose peopling it with a white basis population, as the climate is one of the most salubrious I know, and the soil calculated for sugar cane, the grape vine, the mulberry, and pasturage to an almost unlimited extent. We do not claim the natural richness of your valleys, as we are upon the ridges of the Alleghenies, but our crops and herds are not exposed to the same trials from climate. Our grasses remain green throughout the winter, and our plantations capable of being tended with nameless capital. But I will not enter upon this interesting subject further at present, only promising that if you will find my communication satisfactory, I will suggest in my next, for the consideration of your western landholders, an eligible method of furnishing settlers with landed estates, and still retain for themselves a valuable property in them.

I send by the next mail a small paper edited in connection with our works of improvement in this southern country, and which I think your department will find of service. It is made cheap, that the important interests of which it will treat, may be disseminated at slight cost. I will exchange with you for your interesting publications, which I must request you to send me at your earliest convenience, and although I could not comply with your request, by answering yours time enough for your annual report, it will not be the less acceptable to me from that account. So please send that also.

With sentiments of great regard, I am your obedient servant.

A. H. Brisbane.

P. S. Let the curvatures be never less than $4\frac{1}{2}$ degrees, or about the fourth of a mile radius. I advise the square ribbon, that the lamina of the wood may be placed vertically, as it exfoliates with the weather too much when placed horizontally. If the horse is used, fill the track to the surface of the ribbon within the rails. When steam is introduced, ram and fill the outer part of the ditches.

REPORT OF GEN. BRISBANE, PRESIDENT OF THE OCMULGEE AND FLINT, OR GULF AND ATLANTIC RAILROAD.

To the Stockholders:

Gentlemen—A second year has now closed, and yet our great work is unfinished. It is not to make excuses, but to render a faithful history of our progress for the last twelve months, that I state the circumstances which have interfered so much with our calculations. Death has had a first influence. It is known to most of you that General Jones, of Lee, our late president and able friend, was the first citizen of the Flint country who responded to the proposition to connect this rich portion of the State of Georgia with the Atlantic ocean. He had scarcely time to exhibit his eminent qualifications for executive control, and to evince his earnest devotion to our enterprize, when the silence of the tomb was exchanged for the bustle and ex-

citements of a transitory existence. The great mind, too, that had caught at a glance the bearing of our undertaking upon the interests of his fellow-countrymen, and as quickly identified them with it the late Bishop England of Charleston, has also gone to his rest, and it is now upon the faith of his reputation only that our work may be said to exist. Nor is this all—a third tried and warm friend has left us to feel most sensibly his last adieu—the Rev. Dr. Graham, the founder of the Catholic churches of Columbus and Macon, and the sandalled priest of the Ocmulgee and Flint railroad, departed this life at a time when the utmost energy of his powerful mind was required to strengthen and enlighten our anxious counsels. Gentlemen, few can realize the efforts that have been required to parry the blow which these melancholy deaths have inflicted upon us. Nor is this all; the restoration of labor to its legitimate valuation throughout the world has occasioned such frightful inroads upon contracts made during its excessive appreciation, that the utmost parsimony and diligence united will not restore for some time sufficient confidence to the great body of the community to allow their capitalists to re-extend their credits; all that is now lent is instantly absorbed by debt. This fact has appeared to us under its most formidable aspect. Of a balance against our stockholders of $35,000, due on the 1st of January, 1843, not one cent has been paid, and worse, a compromise of 5 per cent. been refused, and suits legally resisted, under the moral plan of debts due to more necessitous creditors. Nor does this apply solely to the *bona fide* stockholders of the road. On the ground of a common interest in the prosecution of our work. I sought from the merchants of Charleston and Savannah, after having pushed the construction to a point of forwardness insuring its early completion in the past year, that aid which fell proportionally to them. In both instances it was fairly promised, and debts for black labor contracted, covering the respective amounts. You were made aware in my July report of the fate of the Savannah subscription: I now grieve to state a similar one on the part of that of Charleston. Seven thousand dollars—the small contribution of twenty odd of her first merchants, with the exception of one or two faithful adherents—has been allowed to stand against them, and the whole debt incurred upon its credit, made to devolve upon the company; and had it not been for the magnanimity of Messrs. Cook and Spalding, of Darien, upon whom the burthen chiefly fell, an utter failure of the enterprize might have been the consequence. These disasters, too, have had their influence upon the principles upon which our road has been constructed—stock labor. Those who toiled for stock directly, felt that its appreciation was indefinitely postponed—those who obtained it by exchange of supplies for fractional shares found these depreciate in the same ratio; so that even where subsistence was all that was required, that, too, appeared daily to grow more uncertain.

Finding every effort unavailing to discover a palliative at home to these formidable disasters, I called the directory together immediately after my appointment to the Presidency, and under its authority hurried to the great seat of trade, trusting that all improvements of a general nature, wherever located, would be interesting there. But the general reaction in the industrial department of the country had already reached the fountain head, and New York was herself in a state of perfect collapse. Consultations with her ablest financial advisers apprised me of this fact, and I once more had recourse to that source which is never applied to in vain for a just charity. Bishop John Hughes of New York has supplied the place, in our destitute condition, of the "Irishman's champion" on this side of the globe, Bishop John England of Charleston, and the simple accession of this great man's

confidence to our enterprise, has again reassured all parties; his moral influence has nerved the arm of the voluntary laborer, and his pecuniary aid has infused new life into our desponding creditors. Thus, gentlemen, has this great national enterprize not only originated, but its fate been determined from a quarter which the world is yet to learn is destined to do much for the cause of civilization. It is now decided that the Irish laborer is not alone the constructor of our great canals and railroads, but that Irish talent and Irish capital are engaged in the improvement of this immense republic—a field of action commensurate only with the daring and industry of the gallant little island. I myself feel confident that the simple history of the Gulf and Atlantic road, achieved by our brave band—a work which the government has been for fifteen years pondering over, and which is even now being croaked of at Washington, will read a warning lesson to the ears of those who pertinaciously adhere to the opinion that "an Irishman is unfit for self-government."

The actual operations of the road, I am happy to state, are not at all behind the calculations of my last report, when we take into consideration the circumstances above alluded to. The total expenditure for a road of 76 miles, whereon the graduation has been completed, and 50 miles of its superstructure furnished, with the greater portion laid down, and which crosses in its route a rolling country, whose summit level is 300 feet above the rivers whose trade it unites, is $123,000—$100,000 of which has covered its reduction to a grade of 30 feet to a mile, and $22,000 a substantial track, over which the heaviest transportation might be conducted. The labor of 100 men for a few months more ought to prepare the entire line for service. The only regret is, that however soon it may be accomplished, it cannot be made available for the present crop for this has been already carried forward to too great an extent. The actual money expenditure since our commencement has been $9,000; a fact which ought at once to stamp the work with a peculiar interest. It marks an important change in the religious and political character of the world. Barbarous nations erected mounds, pyramids, obelisks to denote their individuality; a christian people construct those works and highways which are calculated to unite God's human family. The first depend for their immediate bonds on the daily bread doled out to them by a selfish hand—the second look for a remuneration to those laws which secure equally to every laborer the just award of his individual industry.

Nor are the debts of the company such as to alarm. That incurred at home and for food, is less than $5,000; that abroad, covering the hire for black labor, the clothing of the force, and a portion of the superstructure, and transportation equipage, is not more than double that sum, or $10,000. This statement should not surprise, for where labor is the fruit of self-interest, economy will be found, as well in the transportation department of industry as in the agricultural; each person by our system has in charge the conduct of the entire enterprise.

It is now my duty to suggest such measures as I feel satisfied will, while they sustain public credit, push forward the work to completion early in the coming fall. They are calculated, too, to meet the depression in the money market to which I have alluded, and give a foretaste of the benefits to be derived by the planting interest in the Flint country from our road. The first is to furnish corn to the company, either on stock, or as an advanced payment on the freight of the cotton of the next crop. The second is to rebuke that spirit of distrust in themselves which has crept into the habits of our people, making them, in less than three years fall from a voluntary liability of $300,000 to an actual payment of $3,000, or a hundredth part of the

debt. An especial meeting of the stockholders should be had, and the notes of each, where monied means were wanting, pledged in one general fund, to secure a loan equal to the entire debt of the company. I am satisfied some capitalist, sufficiently confident of the value of the work, could be found, who would make the loan of **$15,000**, and hold these notes, bearing legal interest, and made payable one year after the completion of the work, as security. There is now due to the company twice this amount, or **$30,000**. I believe that I could find such a friend, and by this measure we would at once put a stop to those disgusting process of law, which are calculated not only to tarnish the reputation of our work, but to delude ourselves and our creditors. I cannot urge too positively this necessary measure, for without it, although I may go on as I have, and with individual loans and charity contributions complete the work, the credit of the Flint country must suffer. Besides, there are too many now dependant upon my individual exertions, and have been too long toiling with faith in them to allow me to rely with too much confidence in them myself. It is the duty of the wealthy Flint country to sustain a work which I only commenced under its auspices, and which will ever redound to its honor and profit. Let our stockholders read with care the series of communications, calling upon congress to construct a similar work to ours, more immediately across the southern peninsula, and apply their every arguments to the character of our work, already almost prepared for mail travel and transportation service, adding farther, the important fact, that General Bernard gave ours the decided preference; and when the honorable the Secretary at War shall make public a communication from the engineer department of this road, addressed to him late in the last year, the reasons of General Bernard's preference will be satisfactorily shown.

While in Washington city, I made a point to visit the post office department also, and am happy to state that nothing will prevent the immediate transfer of the general mail to the track of our road, should its advantages be satisfactorily shown over the present mail route. The links of railroad attaching to ours from extreme north to extreme south I have also visited in detail, and from Governor Dudley, of North Carolina, to the Hon. Louis Mc'Lane, of Delaware, found all ready to acknowledge the important services which our work is calculated to render them when completed. The reputation of our work, gentlemen, has gone abroad before completion; completion, then, becomes a duty—failure to complete a disgrace.

Respectfully, A. H. Brisbane,
President and engineer of the work.

RAILWAYS, THEIR USES AND MANAGEMENT.—LONDON, P. RICHARDSON, 1842.

This is an interesting epitome of all the railways that have been executed and in progress in this country, and is very ably written, affording a brief insight into their cost, working, and management. The following extract, relative to some of our principal engineers, will be read with some interest.

"Most happy should we be if the undertaking had to depend for its success in the parliament upon its own value without the intervention of counsel, as not only would time and money be thus saved, but the real merits of the proposed work would be brought forward more honestly, or if it had not these pretensions and that recommendation, it would lose a false bolster and fall. It is well known that the skill and science of the different engineers is frequently useless to them, with all their assured knowledge, by their failure as witnesses. Thus George Stephenson is never put into a witness-box, if his friends can keep him out, he has not the temper for cross-examination by

persons he considers ignorant of the subject, and with his opinion of himself it would be found impossible to find any person he would submit to. No man however, deserves more credit than George Stephenson, for the manner he has advanced himself in the world, which is in itself no greater proof of his natural abilities, than his acknowledgment of it, is of his real unaffected excellence of heart—he is however a theorist of the wildest kind, and until he became a coal owner, felt that the first things in the world were railways, and the first person George Stephenson. He has, notwithstanding his energy and knowlede of coals, failed to introduce them into public use at a reduction in their price, as he promised he would, and no inland coal will do so, however much its introduction into the metropolis may interfere with the sea-born supply. His railways are not always the best or most profitable, and we think he has made a mistake also in becoming chairman of any railway company. Robert Stephenson, with a higher education is more calm and self-possessed and makes a better witness. Walker, sharp, quick and clever, may always be relied upon for all he undertakes. Sir John Rennie, however, possessed of all the knowledge on the subject, cannot stand the badgering of counsel and forgets his professional service in his gentlemanly feelings. George Rennie is too retired and modest to make known his extensive information and much mechanical knowledge under the ordinary examination of counsel, he must be drawn out, and thus make an honest, conscientious, and intelligent witness. Young Brunel is clever and self-possessed, and would not be easily put down. Locke's testimony would look hard, matter-of-fact, and solid, economical in all its parts. Giles is hasty, anxious, but determined not to be put down; Cubitt, quiet, calm, and firm. Vignolles, energetic and fiery, looking the very personification of some new and wild theory, to be put into immediate practice by his instrumentality, would rather astonish his audience by his bold expostulations and warm support of them, than convince by his arguments and facts, except in matters of detailed and minute expense in practical experience—his evidence has, however, been largely counted on by his employers. Braithwaite is a clever machinist, with an inquiring mind; and in our opinion, has been spoilt by being made a railway engineer; in this latter position his only experience is the Eastern Counties line, and his declaration of the correctness of his original estimates for the whole line to Yarmouth, made at a public meeting a year and a half after obtaining the act, will hardly add to the confidence of the public in his future undertakings; his self-opinion and readiness will always support him, whether as a witness or advocate. Bidder, is, perhaps, the most perfect witness; for though Rastrick has the hardest mouth of any and the most impurturbable determination not to be beaten, yet Bidder, with all the same pertinacity has, in addition, an effrontery of manner (however unintentional) which defies the most resolute opposition; Gibbs is honest and straight forward, and having bought his experience on estimates somewhat dearly on the Croydon, would never again deceive himself, or others."

EXTINCTION AND PREVENTION OF FIRES.

The recent destruction by fire, of much property belonging to railroad companies, affords a suitable opportunity for calling attention to those simple and efficient means which have long been known and successfully adopted for the prevention of fires or their speedy extinction when already kindled. It is hardly to be supposed there would be any backwardness in adopting such means when known, as self-interest, if nothing else, would prompt to their employment. But whether it is that information upon this subject is

inaccessible to those interested (it certainly is not wanting) or that the importance of the matter is underrated; the fact is that a vast amount of property continually exposed to danger from fire, is left entirely unprotected by any preventive application, and is only to be saved when on fire by the use of water, often nearly inaccessible or when obtained, injudiciously applied.

A most effectual preventive against fire, or incombustible paint, is a combination of various salts and earths, which is designed by its ready fusion to exclude all access of air from the wood when once set on fire. The chief requisites are, that the paint should not wash off by rain nor peel off when dry, the materials should be cheap and of easy application. Common white-wash plentifully applied is certainly the simplest and cheapest preparation of the kind. As a proof of its efficacy we have only to pour a quantity of white-wash over a heap of dry brush, and this when thoroughly heated and dried by prolonged exposure to a summer sun, will be found to be absolutely incombustible. There are disadvantages, however, about the common white-wash, such as its slight adhesiveness and disposition to peel off when in thick coats. Various additions have been proposed to obviate these difficulties; salt, ashes, and alum, separately or together, have the property of curing the defects of simple white-wash, and affording a better preventive against fire. From these, in fact, with slight modifications are framed all the principal incombustible paints which have been prepared. A few years since a patent was taken out at Washington by Louis Paimboef for a recipe which, of course, was limited to the proportions there claimed; those proportions, we are told by the editor of the Journal of the Franklin Institute, did not appear to be those best suited for the purpose, for the paint both washed and peeled off. Mr. L. A. Sykes, chief engineer of the New Jersey railroad, made some experiments upon this subject, with a view to the preservation of the valuable bridge over the Raritan at New Brunswick. The result was, that water saturated with common salt and mixed with lime and ashes answered more effectually than Paimboef's composition, the proportion of lime and ashes seems to have been observed with no greater nicety than in the preparation of ordinary white-wash.

As an improvement upon this, we would suggest the addition of a small quantity of copperas, by which a far more desirable tint than the staring white of common white-wash would be obtained, while the quality of the paint would be rather improved than otherwise, a strong solution of alum applied over this last preparation when dry would probably afford the best means of bringing this substance into use and also guard more effectually against washing and pealing.

When some slight binder can be cheaply obtained, common road dust or fine sand may advantageously be added; skimmed milk is commonly used for this purpose. Paimboef used, when this last could not be had, rice water, but a cheap size of glue, or common isinglass would answer as well if not better. In India a solution of coarse brown sugar is used in preparing a very beautiful and permanent stucco or cement. The sugar operates by

increasing the solubility of the lime, and thus producing a more intimate union with the sand, by which the further dissolving of the lime is prevented and no fear of washing need be entertained. Molasses may, perhaps, be economically used instead of sugar, neither of them costing much as used for this purpose, perhaps with either of these last binders, and a sufficient quantity of clean sharp sand, an excellent preparation might be made with the addition of nothing else but common salt to the white-wash.

Soluble glass has been proposed and extensively used for the same purpose. For a full account of the preparation and use of this substance, we refer the reader to p. 806, vol. IV. of this Journal. Soluble glass can be cheaply prepared at the glass-houses, and will answer as well as, if not better than, any other composition; it can also be applied to some of the trimmings of cars which are liable to be set on fire.

The means of preventing the spreading of fires are, simply, the application of some compounds similar to those above named, but yet capable of passing through a fire engine without injury to the machine. Solutions of common salt or ashes, separately or together—or else fire-clay or similar matters susgended in water—are the various forms in which it has been proposed to furnish a speedy fire-extinguisher. A recent number of the Journal of the Franklin Institute contains an able article by D. J. Murphy, Holborn, in which the importance of some such composition is strongly urged; but the recipe there given appears to be in no respect original.

The care with which such preparations may be made and applied, should prompt to all at least a fair trial.

INFLUENCE OF RAILROADS.

We find in some of the papers, a statement that, on the occasion of opening a railroad near Venice, the proper ecclesiastical authority, after pronouncing his benediction, launched out into a bitter tirade against such innovations as railroads, which he thought would facilitate the introduction of *books and liberal opinions.* If this be a fact, we cannot but remark that this worthy was not quite so wrong in his estimate of the actual effects of the operation of railroads, as in his opinion of the usefulness of these effects. In that part of the world, the books and liberal opinions would perhaps do as much for the moral, as the railroads would for the physical, improvement of the people.

There is, however, a high authority for the squeamishness of the reverend father, in the reply of an early Russian monarch to the king of Sweden, who had sent him a clock. The clock was returned, with the remark, that such a piece of magic was not fit for a christian king who feared God, and resolved to have nothing to do with the planets.

Such sentiments certainly do not belong to the reigning Russian monarch, who has projected a magnificent system of railways, and probably offers more encouragement to invention than any other government in the world; nor do they belong to the clergy of the church of Rome in this country, who, according to General Brisbane's Report, published in this number, are among the best friends and most energetic supporters of his railroad enterprise.

LETTER TO THE HON. W. GWIN, MEMBER OF CONGRESS FROM MISSISSIPPI.

SIR: The interest you have taken and the great labour you have bestowed upon the question of steam ships for our Navy, must be my excuse for addressing you a communication which, in some of its details, bears upon that subject.

Since my return from Russia in April last, after delivering to the Imperial Government the steamer Kamschatka, I have been urged by my friends, and those interested in the subject generally, to publish a full account of the circumstances connected with the building and performances of that vessel. The fact that numerous publications, both in this country and in England, have been industriously prepared by those whose means of information were limited, or whose interest impaired the impartiality of their statements, was urged with much force as justifying this course.

The return of the chief engineer, Mr. Joseph Scott, having supplied me with the facts connected with the performance of the ship during the past season, together with the corroborating report of an officer attached to her, I am enabled to state not only what were the original requirements of the Russian Government, but also the manner in which they have been executed on our part, and the degree of satisfaction that has been given.

The Contract made between Captain Von Schantz of the Russian Navy, and R. and G. L. Schuyler, contemplated the building and equipment (armament excepted, but gun carriages included) of a war steamer, adequate to a force of two 10 inch, or 140 lbs. guns, two 8 inch, or 72 lbs. guns on the upper deck, and sixteen long 36 lbs. guns on the second deck—the necessary ammunition—water, provisions, and stores for two months for 200 men and officers, and fuel for 20 days steaming. The draught of water, loaded as above, when ready for sea, to be not over 16 feet, and the speed to be equal to the best of the English man-of-war steamers, viz. about 8 knots per hour as the maximum under steam without sails. The materials were all to be the best of the kind selected and to pass under the inspection of Captain Von Schantz. The engines were to be on the plan of "Lighthall's Patent Half Beam," and the boilers after the tubular arrangement of R. and G. L. Schuyler, inasmuch as the plans both of engines and boilers had been approved by the Emperor, to whom they had been submitted by Captain Von Schantz upon his return to Russia after a previous visit to this country. The performance of the ship will show that all these requisitions were fully answered and some of them exceeded.

The difficulties of the undertaking were well understood by us. We were aware that English engineers, with all their experience, had made attempts to build steamers of this class which had failed; and that the Gorgon and Cyclops, constructed under the immediate superintendence of Sir William Symonds did not carry the armament or the fuel intended. It was also questionable at that time whether the heavy wrought iron work necessary for such a steamer could be procured at short notice in the United States.

With what success these difficulties were encountered may be judged of by the statement I shall now submit to you, and by extracts from the report to which I have alluded.

The Hull.—A model was prepared under the directions of Captain Von Schantz after the form and principles of moulding, common in Europe, with improvements by him, especially in the upper works and stern. This model in the part below water was by no means satisfactory to us, nor, as we considered, of adequate displacement. We then prepared a model on the principles we urged as essential to the success of the ship, having particular re-

ference to the water lines and floor, and not intended to show the top or stern we should propose, as those in the first model were so satisfactory as to require no essential change.

This model was prepared for us by Mr. William H. Brown, ship builder, who had been for many years employed by us, and understood perfectly our ideas upon this subject. A third model was then made corresponding substantially to the one proposed by us for the water lines and floor, and to the first one for the top and stern.

From this was the Kamschatka built, and the lines of all three are now in our possession. Having assumed certain weights for engines and boilers, (which, to a great extent, could only be matter of supposition in the then condition of the calculations,) and having established the necessary displacements, measures were taken without delay to commence the construction of the hull. A contract was made by us with W. H. Brown who laid the keel in the end of February, 1840, and the ship was launched the 24th of November following. The accuracy of the calculation as regards the weight of the hull and its displacement was then established. The calculation by Captain Von Schantz was 998 tons; by us, 1007 tons. The actual displacement, deducting known weights of some machinery then on board, was 1008 tons.

The draft of water differed less than one inch from the estimates.

The interior arrangements of the ship, exclusive of the engine and boiler rooms, together with all the nautical department, were planned by Captain Von Schantz, and executed under his direction. The gun carriages and platforms were likewise constructed from his drafts.

The Engines.—At the time the contract was made, it was expected that Mr. Lighthall would take the situation of engineer, and that we should have the benefit of his suggestions in adapting his patent to a sea steamer. Other engagements prevented his fulfilling his agreement with us, and left us to construct the engines on his principles, after our own ideas.

The arrangement of the engines being entirely new, though the various parts composing them were easily proportioned and designed, the difficulty of combining an adequate frame for their support, was soon found to be of no small magnitude. Not only was great strength required, but it was essential so to distribute it as to meet the various strains to which the engines of sea steamers are liable. On the arrival of every steamer from England, our investigations confirmed the opinion we had formed, that this portion of the marine engine was far from being perfected.

In the voyage to Russia, which was as tempestuous as any yet made by a steamer in safety, and up to the close of the present season, this frame has not failed in any respect; and it is believed to be one of the few to which additional braces and fastenings have not been added after the test of actual service.

It may not be improper to say, that the system of wrought iron bolts, adopted in this frame, has since found its way into English steamers, plying to this country and elsewhere.

The frame, steam and expansion valves, side pipes, condenser and air pumps of these engines, were constructed, and the whole set up, by H. R. Dunham & Co. under the immediate superintendence, and with scarcely any exceptions, from the drafts of Mr. Robert Schuyler.

The Boilers.—The boilers of the Kamschatka have been the subject of much discussion. When the late Board of Navy Commissioners was receiving proposals for the engines and boilers of the Missouri and Mississippi, the plan of boiler invented by R. and G. L. Schuyler was laid before them,

and its consideration urged on the ground of the importance of burning anthracite coal in our war steamers. The advantages of anthracite over bituminous coal are too obvious to require much comment, but may briefly be enumerated under the following heads:

It is the produce of our own country.

It burns without sparks or smoke.

It has less weight in proportion to the bulk; is free from all risk of spontaneous combustion; and, owing to its hardness, does not slack from the motion of the vessel. In time of war, steamers using bituminous coal will find great inconvenience, from their position being always known to an enemy by their smoke, long before they can see or be seen, and anything like secret movements at night are impossible. The use of anthracite coal remedies this difficulty. Steamers can be kept in as good order, and their sails as white as those of ships; a matter of no little moment in a service where cleanliness is an important branch of discipline. The risk of setting fire to canvass when used with steam is also entirely overcome.

Anthracite coal is now generally used with success in our river steamers; but it is effected by means of an artificial draught; and the quantity of coal consumed per hour is such as to render that mode questionable for sea steamers.

The boilers of the Kamschatka have fully answered our expectations; and while they occupy less space than any boilers constructed to supply engines of the same size here or in England, they have adequate fire surface, and consume less fuel to generate a given quantity of steam, than any others with which I am acquainted. They also can be used for both descriptions of fuel, without any assistance from blowers. We have smaller ones on the same principle in daily use in this harbour, burning anthracite without blast, in which to evaporate a given quantity of water, the ratio of the consumption of fuel in money is as three dollars, where other boilers around us demand five or six.

In September, 1841, the Kamschatka was completed and the fuel and stores for the voyage put on board. The precise weight of the gun, in pigs of lead, was placed in each gun carriage to test the requirements of the contract, and with the crew on board, ready for sea, and extra machinery, which more than compensated for the difference in the compliment of men, the draught of water was precisely the sixteen feet named in the agreement.

The estimated weight of engines, engine frames, boilers and water, had been assumed from the preliminary calculations at 1,009, 120 lbs. ($450\frac{1}{2}$ tons,) the actual weight when completed was 1,015,392 lbs. ($453\frac{3}{10}$ tons,) a variation of about 6,000 lbs. in a calculation embracing upwards of one million.

The Kamschatka left New-York for Cronstadt about the first of October. In consequence of the lateness of the season, the only trial of her engines before starting on her voyage was a trip of four hours to Sandy Hook and back. Some details of that voyage, in a letter written by me at Southampton, were published in the New-York Courier and Enquirer of November 11, 1841. The passage was made in 21 days, during three of which, for the purpose of testing and reporting upon her sailing qualities, no steam was used. I refer those who consider the Kamschatka a failure, because she did not make the passage in 12 or 13 days, to the fact that though the Cunard steamers *have been* across in that time, yet upon this occasion, the Caledonia, which left Boston on the 1st October, was 20. days, steaming all the time; and, though the same vessel *has been* from Boston to Halifax in 40 hours, the time required for this passage was 6 days. The gale of October, 1841,

was encountered by the Kamschatka on the edge of the Gulf Stream without any detriment to engines or waterwheels, while the Caledonia close under the land, shipped seas, carried away spars, disabled her waterwheel, and would have been compelled to make a port had she been bound for England without intending to touch at Halifax. The English papers in giving an account of her passage were very confident that no other steamer than one of the Cunard line, would have lived to tell the story.

The voyage across the Atlantic, considered as a test of the performance of the Kamschatka, was perfectly satisfactory, and was so reported by Captain Von Schantz to his government. Nothing could be more perfect than the working of engines; but it was discovered on the second day out, that there existed leaks to a considerable extent in the small connections of the flues of the boilers. Any practical engineer can readily understand how much their efficiency would be impaired from such a cause, though apparently trifling in itself. As I have always spoken openly of this leakage as the only misfortune connected with the mechanical execution of the work; it has doubtless been the foundation of some of the reports that the boilers had entirely failed. I now wish distinctly to state in justice to ourselves and to H. R. Dunham & Co., the builders, that these leaks were of a character very common to new boilers, particularly when built of copper and of a large size. Of the 6,400 tubes they contain, not one has ever leaked or failed in any manner; and I have the authority of Mr. Scott, the chief engineer, confirmed by the report to which I have previously alluded to state, that upon our arrival in Russia, a few days labour in caulking obviated the difficulty entirely; and that during the past season they have never given any trouble on that score or any other, or required one dollar for repairs. Had there been time before leaving the United States for the experimental trip as far as Charleston and back, stipulated in the contract, this difficulty would have been easily remedied before her sailing. Indeed, I think much credit is due to the builders engaged in fitting up the Kamschatka in every department, that, hurried off as she was without trial, no other than this trifling difficulty presented itself. Those who are familiar with the experimental trials of the Great Western, British Queen, President, and even the Missouri and Mississippi can appreciate the hazard we encountered in permitting her to depart under such circumstances.

Upon our arrival at Southampton we were immediately honoured with a visit from Mr. Benkhausen, the Russian Consul General in London, accompanied by a ship-builder or engineer, who gave the vessel a hurried inspection, making his enquiries of everybody but the officers, and who left her in a few hours for London. The Consul General drew up a report from this visit, which was sent to St. Petersburg in advance of our arrival; the substance of which was, as I was there informed, that the Kamschatka was a failure—that her price was enormous—and that better and more powerful steamers could be furnished in England for a great deal less money.

When contracting for the Kamschatka, we were well aware that we should have a powerful English influence in Russia to contend against, and it was on that account stipulated that we should supply her with American engineers for one year after her delivery. All the steam ships procured by the Emperor out of his own dominions, up to that time, came from England, the engineers were principally English; and Gen. Wilson, an Englishman, is at the head of the Government machine shops and manufactories at Colpino. The same builder that accompanied Mr. Benkhausen on board the Kamschatka is said to have received from that gentleman, all the contracts

for steamers for the Black Sea, and doubtless felt some anxiety, and had some interest in depreciating American workmanship.

Preceded by this report of the Consul General, we pushed up the Baltic through snow, sleet, and ice, in the month of November, and anchored at Cronstadt. The performance of the ship on this voyage with English coals, anthracite having been previously used, was also satisfactory. It had been the intention of the Emperor to be present at a trial of the steamer immediately on her arrival—for this, however, the season was too far advanced. In a few days the harbour of Cronstadt was entirely frozen over, and all trial, and even inspection, by the Emperor was necessarily postponed until the following spring. This gave an opportunity to the English employés of the Russian Government too good to be lost.

Armed with the report of the Consul General in London, there was no end to the stories that were put in circulation about the ship, to the imputations cast upon me, or to the difficulties thrown in my path. General Wilson, after making calculations to prove the engines to be of 260 horse-power instead of 600, and reporting that the Government had been *cheated* by us out of the difference, went so far as to recommend that they should be taken out and adequate ones procured from England. It is not impossible that his recommendations might have been adopted, had it not been suggested that it were as well to try them first. I will not detain you by giving any details of the measures adopted by me to repel these attacks, which I considered national as well as personal; suffice it to say, that the high sense of justice and honour of the Emperor Nicholas, as soon as my statement of facts was made known to him, caused me to be relieved at once from the personal embarrassments in which the action of Prince Menchikoff, the head of the Navy Department, had, under this English influence, involved me. The Emperor's opinion, openly expressed, that as far as he knew, the steamer was satisfactory as regarded her price and performance, was quite enough to silence for a time all cavillers at St. Petersburg.

I mention these circumstances to account for an impression which I find has been general, that the Kamschatka did not answer the expectations of the builders. General Wilson's statements were widely circulated in England and thence found their way to this country. Indeed, some papers in England have asserted, that the machinery was actually taken out, and attributed her performances this summer to the excellence of English engines, even under the disadvantage of being placed in an American model. General Wilson, up to November last, had never visited this steamer in person. He has not confined his hostility to mere statements, but has taken advantage of his position to throw every obstacle in her way. While large sums were expended to improve the steamers that were to compete with her, and picked men placed in the engine departments, convicts were considered by him good enough assistants for her American engineers. The nature of the article in the London Mechanic's Magazine, together with the general character of that journal, is such as not to require any answer. We have since then, however, been applied to by Mr. John Weale, at the request of several engineers in England, for plans of these engines and boilers in his forthcoming work on war steamers. That work, when completed, will afford engineers in England an opportunity fairly to criticise them, when we shall be ready, if necessary, to defend them against unjust attacks.

I proceed to make such extracts from the report previously mentioned and that of Mr. Scott, her engineer, as I think justify me in asserting that the steamer has done more than was expected from her in the original agreement.

"In the middle of May the Kamschatka hauled out of dock, with a crew of 250 men, 200 shells for each of the four big guns, 75 round shots for each of the 36 lbs. guns, provisions for two months, water for six weeks, and 500 tons of coal, bound on a cruise to Finland in company with the second best steamer in the Russian Navy, on board of which was the Grand Duke Alexander, the Emperor's eldest son. Steaming with her four boilers, the Kamschatka easily *ran round* the other vessel."

"Her second cruise was in company with the Bogatea, the largest and fastest man-of-war steamer in the Russian Navy, to bring the King of Prussia to Cronstadt. This trial had been anxiously expected by all on board; but what sea going steamer can keep up with one which makes never less than 11 and frequently up to $12\frac{1}{2}$ knot per hour as the Kamschatka does? This trial fully settled all questions as to her speed. As a last resource to the English faction, it was declared that if driven up to such speed, her boilers must undoubtedly burst as those in American boats always do; for through the means of English papers, we are provided with full accounts of all disasters to American steamboats. The Prussian King, however, was brought safely to Cronstadt and back again to Prussia, the Kamschatka carrying from 12 to 15 lbs. of steam, and making 12 knots per hour. The Captain received the Prussian order of the Black Eagle and a diamond ring with the King's initials. Her next trip, the Emperor, accompanied by a numerous suite, proceeded in the Kamschatka to inspect the whole fleet then out in the Finland Gulf. We left Cronstadt at midnight with a heavy blow right ahead. During the whole night we made $10\frac{1}{2}$ knots dead to windward—driving the spray over the ship from jib-boom to taffrail. The next day the wind abated and the fleet was inspected. On our return to Cronstadt the Emperor took the Captain by the hand, expressed in the fullest terms his entire satisfaction as to her performance; said that he considered her a cheap vessel, and presented him with a magnificent diamond ring. The Kamschatka made one more trip to Revel, having on board the Consort of the Grand Duke Michael.

"On the 2d of October, the Kamschatka was again ordered out and left Cronstadt to go to the relief of a Russian line of battle ship lost on the coast of Norway. Two crack steamers, one French and one English, left Cronstadt ten hours before us; we encountered a tremendous gale of wind and arrived at Copenhagen 24 hours before either of the other two. We ran the distance from Copenhagen to Elsineur in one hour and three quarters; we once hove the log during this time—the line ran out with $12\frac{3}{4}$ knots before the sand had gone through a 14″ glass. We remained nine days on the coast of Norway, and on our return at that late season made our run from Copenhagen to Cronstadt in 66 hours, which never has been done by any other steamer.

"I give you, in conclusion, the data from which you and all other engineers can estimate the performance of the steamer—average steam 16 inches, cutting off at half stroke; $17\frac{1}{2}$ revolutions of a 29 feet wheel; vacuum $28\frac{1}{2}$ inches. She consumes, going easy with a 40 inch cut off, one ton per hour; at a speed of $11\frac{1}{4}$ to $11\frac{1}{2}$ knots 38 tons for 24 hours, and forcing her up to 12 and $12\frac{1}{4}$ knots 42 tons in 24 hours, of bad and rotten English bituminous coals, such as we always have in Russia. Her yards and top-masts are got down in 7 and up in 13 minutes. In beating to quarters, her bulwarks are unshipped in $2\frac{1}{2}$ minutes, her big guns can be loaded and fired every 50 seconds, and steam can be made from cold water in 1 hour and 15 minutes. The boilers are free from leaks, and not one tube has been taken out or replaced."

The above extracts from this report are fully corroborated by the statements of Mr. Scott, as regards speed and consumption of fuel. He also states that he has had no difficulty with the engines and boilers; that the latter are perfectly tight, and supply, if necessary, 20 lbs. of steam. That a consumption of one ton per hour of English coal of inferior quality, supplies her engines with 12 lbs. of steam, cutting off at 40 inches, or one third, with which they will average 14 revolutions per minute; and that to carry 18 to 20 lbs. of steam, cutting off at 60 inches, or one half, the consumption is less than two tons per hour, of the same quality of coals.

The last subject to which I shall call your attention, is that of the comparative cost of the Kamschatka, and the steamers Missouri and Mississippi, which was discussed with much acrimony by a writer in the Philadelphia North American, of November 16, 1841. I shall not enter into the calculations of the writer as to the tonnage, fastening, &c., of the respective ships, because they are founded either upon gross ignorance or intentional misrepresentation. I assume the position that the Kamschatka is as costly as the Missouri and Mississippi, allowing for the difference between the value of white oak and live oak—being as large, as well built, and well fastened, and with engines of the same power. Neither do I claim that her cost should be greater, because those steamers carry no guns on the second deck, it being evident that their construction would admit of such additional force, if desired, provided that their draught of water would allow the ports on the second deck to be cut.

The cost of the Kamschatka, when ready for sea, including all expenses of every description, exclusive of the amount agreed to be paid R. & G. L. Schuyler, was \$418,919, $\frac{57}{100}$.

The cost of the steam ships Missouri and Mississippi, to the 31st December, 1841, as stated by the Secretary of the Navy, was \$1,072,882,$\frac{89}{100}$, or \$536,441,$\frac{44}{100}$ each—to which is appended this remark: "Other expenditures have since been made, presumed to be *comparatively small*, but the accounts have not yet been returned to the Department."

The difference of the cost between a live oak and white oak frame for the Kamschatka would have been, at the outside, \$20,000.

Although an enquiry recently made by Congress on your motion to the Navy Department will show, it is presumed, the exact cost of the Missouri and Mississippi, I feel quite safe in asserting, that it exceeds that of the Kamschatka *one-fourth* for each steamer.

You will note, moreover, that in the cost of the Kamschatka, large sums are included for charges, from which Navy Yard vessels are exempted; such as lease of the ground for building the ship, wharfage, salaries and wages of every person employed in and about her; expenses arising from want of fixtures. I may instance the cost of placing the boilers in the ship, which was \$2000. Extra prices were likewise paid with the consent of Captain Von Schantz upon some heavy contracts, to enable the vessel to be completed by September, 1841.

I leave this subject with one concluding remark. In consequence of building the Kamschatka at the same time with our two government steamers, a competition in regard to them naturally arose. This feeling has in some instances been made to bear upon us as if we were not properly interested in the success of our own steamers. To our friends generally, and especially to those attached to the Navy, it would be unnecessary to advert to this subject; but I take this opportunity to state publicly, that all our plans and experience are now, and always have been, at the service of the Navy Department; and that in any criticisms, made here or elsewhere, no reference has

been had to individuals, but to the system adopted by the late Board of Navy Commissioners.

Notwithstanding I throw myself open to the imputations of those who may think my opinions are founded on self-interest, I cannot but maintain that the only mode for our Government to obtain economical and efficient war steamers, is to have them built by contract with responsible individuals, under the superintendence of officers of the Navy. It is by this method only that the skill of our engineers and mechanics can be fully developed; which, if fairly done, need not fear competition with that of any country.

I have the honour to be, with great respect, your ob't serv't,

GEORGE L. SCHUYLER.

New-York, Jan. 30, 1843.

A FEW STATISTICAL FACTS ON THE REVENUE AND EXPENDITURE OF THE TWO MOST EXPENSIVE LONG, AND TWO MODERATELY EXPENSIVE RAILWAYS. BY JOHN HERAPATH, ESQ.

At a time when so much is said upon the question of good and bad railways, and when traffic and expenditure are matters of warm discussion, I have thought a few calculations and observations on the recent reports may not be unacceptable. For the purpose I have in view, I have selected two of the most costly long lines, the Birmingham and Great Western, and two of those which are considered reasonable in their cost of construction, namely, the Grand Junction and South Western.

It will be seen that, in my comparisons, I have had labor which has not been lessened by the very dissimilar manner in which the companies keep their accounts; but, if it will at all aid those to form sounder notions who are anxious to embark in railway property—for I can hardly expect it will be of much service to old railway stagers—I shall consider that my time has not been misspent.

I trust that my readers will distinctly bear in mind that my computations are based upon the data furnished by the last reports of the companies, for the genuineness of any of which data I do not hold myself answerable. If there has been any cooking in any of the accounts, the sin of it is none of mine. All that I hold myself accountable for is the calculations, which I have endeavored to make, and which I hope will be found, correct.

By the last half-yearly reports of the London and Birmingham, Grand Junction, South Western, and Great Western, Companies, the amounts called up in shares and loans, excluding shillings and pence, are—

	Lond. and Birm.	Grand Junction.	South Western.	Great Western.
Shares,	3,615,897	1,780,490	1,825,507	3,009,311
Loans,	2,278,654	483,362	630,100	3,332,025
Totals,	5,894,551	2,263,852	2,455,607	6,341,336

This is what I consider pure capital, disentangled from other items with which the accounts are encumbered. For instance, in the London and Birmingham account is a sum of £9,561 for "premium realized on the reserved new £32 shares," which, though put into the capital account, appears to me to be more of a contingency than, *bonâ fide*, a part of the capital. Again, in the Grand Junction, there is about the same sum made up of sale of refused shares, and of materials which, not having included at the time I made the calculations, though the sale of the refused shares forms certainly a very legitimate element of the capital, is not comprehended in the above statement. So £24,449 made up of "profit on shares," and "interest," carried to capi-

tal in the South Western, I have not called part of the capital, for the same reason as in the London and Birmingham, namely, that it appears to me to be a kind of accidental windfall, rather than legitimate capital. The same might be said of about £3000 in the Great Western account, for "registration fees" and "rents." This company is the only one of the four which does not exhibit a capital account, but gives simply a balance sheet of receipts and expenditure, including the half year's traffic and expenses. In the South Western, £296,545 belonging to the Gosport Branch is at present tantamount to a loan, having only 5 per cent. interest now paid on it. In August next it will be converted into shares, and receive a dividend. At present, however, it diminishes the share capital, and augments the debt, of the company, from 27.15 per cent. to 60.60, as in the following summary:

Thus, for every £100 of actual capital raised by shares, the

London and Birmingham	have severally	£63.03
Grand Junction		27.15
South Western		34.52 or 60.60
Great Western		110.72

of borrowed money taken up either on mortgage or loan notes. It appears, therefore, that an amount of debt nearly equal to two-thirds of the entire property of the shareholders stands against the London and Birmingham Railway; and a debt of something more than a fourth of their property against the shareholders of the Grand Junction; and in the South Western, of above a third; while in the Great Western the debt exceeds, by nearly eleven per cent., the whole property the shareholders have in the concern. It is not for us to say whether the legislature did, or did not, contemplate such very large debts as are here contracted. Fortunate, however, it certainly is, that in the first, and particularly the last, of these lines, that their per cent. profit upon the whole capital and debt together, exceeds that of their debt; for, were it otherwise, the shareholders would be in a most melancholy position. As it is, it is a great advantage to them to be in debt, and we should recommend them to keep so as much and as long as they can.

The Grand Junction have, by a little dexterity, reduced their capital to only £2,203,300. For, finding their shares at a high premium, they very adroitly hit on an expedient of paying off their debt at a considerable saving to the company, and, at the same time, with great benefit to the shareholders. For instance, they created 17,624 quarter shares, representing in capital only £440,600, and they say to the receivers of these, "Now, if you will take upon yourselves to pay the interest of the debt, and the debt itself, as it falls in, we will give you the full dividend upon these quarter shares, and, when you shall have paid off the debt, we shall save in capital near £100,000." As yet, only 2*l.* 10*s.*, or £44,060, have been called up, and these quarter shareholders stand in this position:—they are receiving at the rate of 3*l.* per annum on the 2*l.* 10*s.* paid up, out of which they have to pay 1*l.* 2*s.* 6*d.* per annum, for interest, leaving 1*l.* 7*s.* 6*d.* net for their clear dividend on their 2*l.* 10*s.* share, or about 54 per cent. But, as a set off, they have still to pay about 27*l.* 8*s.* 6*d.* on each of these quarter shares, besides the already paid sum of 2*l.* 10*s.*; that is, the quarter shares will cost somewhere about 30*l.* each.

In the same way, the London and Birmingham Company are paying the full dividend on their quarter shares, on which only 5*l.* has been paid. I have never, however, heard with what prospective advantage to the company this was done. The Grand Junction plan is a good contrivance eventually for saving capital to the company, though at present at the expense of the

other shares; but the London and Birmingham plan appears to me to be now damaging the original holders, and with no prospective benefit.

Supposing D to be the per cent. amount of debt on the capital actually paid, or the per cent. interest on it, i the per cent. interest on the capital and debts together which the profits would pay, and s the per cent. dividend on the shares or capital alone after paying the interest, we have the following simple equation from which to deduce any one from the rest, namely:—

$$100\,s + \mathrm{D\,d} = (100 + \mathrm{D})\,i.$$

$$\text{Whence } s = i + \frac{i - \mathrm{d}}{100}\,\mathrm{D} \text{ and } i = \frac{100\,s + \mathrm{D\,d}}{100 + \mathrm{D}}$$

By the second equation it appears that if the debt was about one-fourth of the paid-up capital, and the interest of the debt was 5 per cent., and the concern paid $11\frac{3}{4}$ per cent., the shareholders ought to divide nearly $13\frac{1}{2}$ per cent. This, as we shall presently see, is the case with the Grand Junction, considering their loan as a debt; but they have only divided 12, in consequence, chiefly, of the heavy sum they have laid by for depreciation and a reserved fund, and the operation of the quarter shares.

If we were to go closer into details, they ought to have a better dividend than we have given them, because we have not taken in the whole of their half-year's income, nor £9000 balance on the preceding account, while we have comprehended every item of their expenditure for the half-year, and have only reckoned the debt 25 per cent., whereas it exceeds 27.

If the debt was two-thirds of the paid-up capital and interest together, and the profits would return 10 per cent. on the whole debt and capital, the shares, with 5 per cent. interest on the loans, might divide near $13\frac{1}{3}$ per cent. on the paid-up capital. This is nearly the position of the London and Birmingham Company. Owing, however, to the large sum set apart for depreciation and the quarter shares, on which, as I have said, only *5l.* capital is paid up, receiving the full dividend as if *25l.* had been paid, the old shares only receive $9\frac{1}{2}l.$ per share, or about $10\frac{1}{2}$ per cent. Such is the unfortunate operation of these preference shares and the depreciation fund. It is true we have reckoned the debt larger, and, therefore, more advantageous than it is to the shareholders, and have taken the interest divisible upon the total cost greater than it really is; but after making due allowances for all this, the dividend on the shares would cover 13 per cent., if it was not for the operation of the preference shares and the depreciaton fund.

With the South Western they only pay 5 per cent. interest on the Gosport branch, that is, on an additional £296,500, which reduces their paid-up capital to £1,529,000, and increases their debts to 926,600*l.*, or to above 60 per cent. of it. On the total of capital and loan, we shall find presently that this company can pay $6\frac{3}{4}$ per cent. Therefore, allowing 5 per cent. upon the debt, which is $\frac{3}{5}$ths of the paid-up capital, and we shall have 7.80 for the dividend per cent., which might be made on the shares. The amount divided is near $7\frac{3}{4}$ per cent., very nearly the full one, and they hold a balance of 8750*l.* in hand.

The Great Western would pay 5.8 per cent. on the loans and capital, and has 110.7 per cent. of paid capital in loans. Therefore, if 5 per cent. be paid on these, the dividend ought to be 6.7 per cent. on the shares. At the last meeting, a dividend of 6 per cent. was declared.

The length of line run by the London and Birmingham, including the Aylesbury branch, is $119\frac{1}{2}$ miles; of the Grand Junction, including the Liverpool and Manchester, and Chester and Crewe, it is about $133\frac{1}{2}$; of the

South Western, taking in the Gosport branch, 92¾; and of the Great Western, including the Bristol and Exeter, and Cheltenham Union, 169 miles. Hence, taking the receipts earned during the past half-year, exclusive of other sources of revenue, and the expenditures, we have—

	Length worked miles.	Half-year's Receipts.	Half-year's Expend.	Receipts per mile.	Expend. per mile.	Per centage of expen. on receipts.	P. ct. on cap. and loans for ½ y'r of Receipts	P. ct. on cap. and loans for ½ y'r of Expen.	½ yr's profit per cent. on Capital and loans.	½ yr's profit per cent. on Paid up cap. alone	Cost per mile.
		£	£	£	£	£	£	£	£	£	£
L. & B.	119½	429023	134684	3590.2	1132.3	31.685	7.2782	2.3061	4.9721	6.53	52396
Gr. J.	133½	238207	104988	1784.2	784.6	43.973	10.5220	4.6375	5.8845	6.80	21525*
S. W.	92¾	153162	70284	1651.3	757.8	45.889	6.2372	2.8622	3.3750	3.91	26475
G. W.	169	337008	152787	1994.2	904.1	45.336	5.3145	2.4094	2.9051	3.35	53968

* This is given by Mr. Moss, the Chairman. The other costs per mile are computed upon the number of miles constructed.

This table affords us some very instructive information.

Many persons, for example, imagine that the amount of traffic per mile per week, as given in the Railway Magazine at the request of some high authorities, is indicative of the value of the line. Taking an extreme case, this would be true, for if a line had no traffic at all, it evidently could be of no value. But the gross amount of traffic, or the amount per mile, goes a very little way towards deciding the merits of a line. For instance, we have here the London and Birmingham at the head of all the railways in receipts, and more than double of another railway, the Grand Junction, which divides upon its whole cost, and with the dead weight of the Chester and Crewe hanging upon it, near 2 per cent. more. Receipts, therefore, are poor criteria of the merits of a line. They are good tests of the quantity of business done, and of the foundation on which profits may be made, but go no further.

Others, again, think the expense per mile a proof of the economy or extravagance of a company in the management of their affairs. This is a position equally as absurd as the preceding. The London and Birmingham is, upon this principle, nearly twice as extravagant as the South Western, and yet it would pay, upon the whole cost, near 3 per cent. per annum more dividend. Again, the Grand Junction is, if expenses per mile are a test, less economical than the South Western; nevertheless, it pays a good way towards double the dividend. A little reflection would tell us that the mileage expenses are influenced more by the amount of business done, than by the economy of management. But there are some, and even public writers, who have such crude notions upon railways, as to make high mileage expenses a ground of complaint against companies.

Equally absurd is another point on which much stress has been laid. I allude to the expenses per cent. of the traffic upon the receipts. Many persons exclaim, if one company transacts their business at a higher per centage than others, that things are worse managed there than where the per centage is much less. Referring to our table again, and we shall perceive the unsoundness of this doctrine. The Grand Junction is near 40 per cent., on the per centage expenses, more expensive than the London and Birmingham, and

nevertheless can divide upon its whole cost at the rate of $11\frac{3}{4}$ per cent., while the London and Birmingham cannot divide 10. Again, the South Western is apparently paying a higher per centage expense on its receipts than the Great Western, and the receipts per mile are much less; and yet it pays at the rate of $6\frac{3}{4}$ per cent. on its cost, while the Great Western cannot pay at the rate of 6 on its cost, though it has divided, and apparently justifiably, at the rate of 6 on the paid-up capital.

The fact is, the per centage expenses depend upon two things, the fares and the amount of business. Other things alike, if the fares are higher, the per centage expenses will be less, and *vice versa.* Again, the more business, the less in proportion is the expense at which it can be done, simply because the standing expenses will bear a less proportion to the receipts, when great, than they will when little. For my part, I would rather see, where there is a scope for business, the per cent. expenses high, for the probability is there would be much more trade and profit.

The fact is, receipts or expenses per mile, or per centage expenses on receipts, are all fallacious foundations upon which, separately, to ground an opinion in favor of any line. *Railways are strictly commercial enterprises, and it is the annual per centage of profit alone on the capital, as in any other undertaking, that determines its value.* The smaller, therefore, this capital is, the more likely the line is to pay, and hence every effort should be made, in the construction of the line, to keep the cost down. Had the London and Birmingham, with its immense trade, (nearly double that of either of the other lines,) been made at anything like its original estimate, or like the cost of either the Grand Junction or South Western, it would, with its economy of working, have paid a magnificent dividend. The same, no doubt, would be the case with the Great Western, when it comes into its full receipts, which will not probably be for these two or three years. Never was economy of construction more forcibly exemplified than in the comparison of the London and Birmingham and the Grand Junction. With more than a double business, and an expenditure proportionably much less, the Grand Junction leaves the London and Birmingham far in the rear of profitable undertakings, for no other reason than that the total mileage cost of construction of the one has been about 143 per cent. more than that of the other. But the Grand Junction, nearly the lowest of the four in the amount of its business, having been constructed the cheapest, stands at the head of them all as a commercial speculation. Railway Mag.

VARIABLE ORIFICE OF THE BLAST PIPE OF LOCOMOTIVE ENGINES.

In the February number of the *Journal*, I described a "*Self-acting Expansion Slide Valve*," and in the course of the explanation, referred to having obtained patents abroad for an apparatus, by means of which, the orifice of the blast pipe of locomotives can be regulated by the engine driver; I will endeavor in this paper to describe the apparatus, and to point out its general utility.

The determination of the area of the orifice of the blast pipe, is of importance in the construction of locomotives; upon its proportion depends the supply of a sufficient quantity of steam for the service of the engine, and also its comparative effective pressure upon the piston. It may be made so large or so small, as to prevent the engine from performing her allotted amount of duty; and the application of this blast of steam, may be considered (next to the boiler itself,) the most useful invention in this beautiful machine, so essential a complement thereto, that the locomotive engine would have been very imperfect without it. The possibility of its successful application hav-

ing been ascertained, experience promptly indicated the extreme limits of the area of the blast, within which the engine could exert her power; but it still remains to be decided as an invariable rule, what the exact size should be within these limits, to produce the most useful effect; and you will very seldom find any two engineers who adopt the same sized blast, for engines of the same power.

When the diameter of the orifice of the blast pipe is too great, the energy of the blast will decrease, and the draught through the fire will not suffice to generate the quantity of steam required to keep up the speed of the engine; when, on the contrary, the diameter is too small, the resistance behind the piston will become so great, in consequence of the steam not being able to escape through the contracted passage, as sensibly to reduce its effective power on the piston. Within these two extreme limits (if an invariable orifice of blast is adopted) it at first sight appears, that there must be an intermediate point at which, if it could be attained, an engine would perform the greatest quantity of work, with the smallest quantity of fuel. This intermediate point, if it can be admitted to exist, is exceedingly difficult to discover, because a locomotive engine has to overcome a degree of resistance that is constantly changing, either on account of the load, the action of the wind, the state of the rails, or other causes.

In the preceding paragraph, speaking of the extreme limits of the size of blast, within which an engine may work equally well, some doubt is expressed as to whether there exists an intermediate point that might be preferable, as enabling the engine to perform more effective duty. It is probable that within a certain limit, the blast (if invariable) may be made of any intermediate size, without sensibly influencing the average effect produced, the inconvenience and advantage resulting from the change being so nicely balanced, that no sensible difference could be discovered. If such is allowed to be the case, the efficacy of the variable blast must be manifest without a trial.

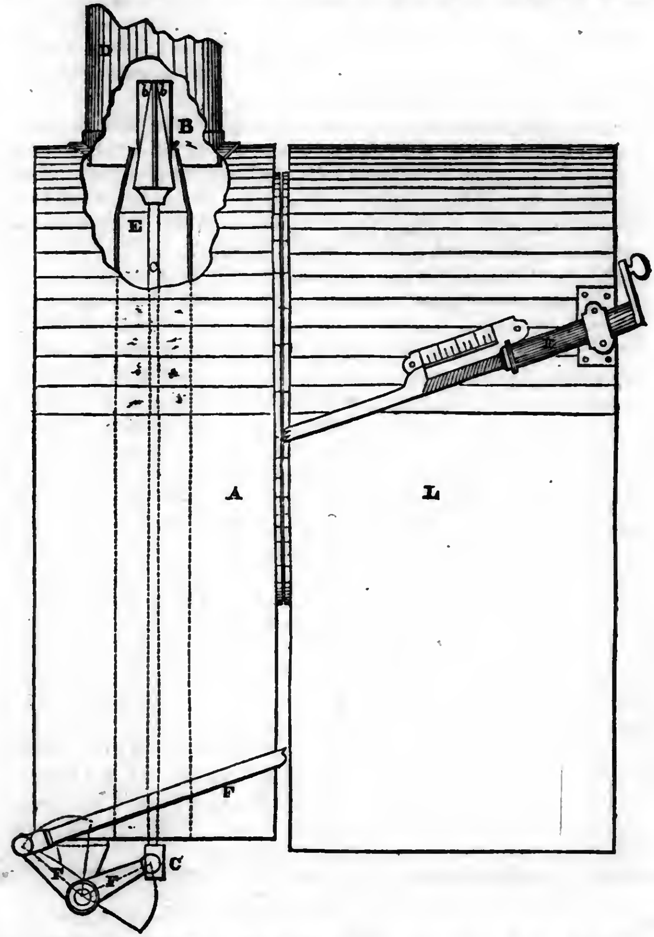
In order to diminish the resistance behind the piston at the return of the stroke, the elasticity of the steam has been taken advantage of; a chamber placed at the foot of the blast pipe, by allowing the steam to expand on its escape from the cylinder, relieves the engine, and has permitted the adoption of the most contracted orifice of blast, that I have yet seen successfully employed. The greatest relief, however, has been obtained by throwing off the steam considerably before the piston arrives at the end of the stroke, thereby enabling it to expand before the return of the piston, and thus very effectually diminishing its resistance; and although by so doing a portion of the effective power of the steam is lost, it is at the same time a judicious choice between two evils, and if not adopted, the discharge of the steam from the cylinder at the moment of the return of the piston would determine a powerful resistance to its free action, and so reduce the effective power of the engine.

The contraction of the blast pipe being an inconvenience inseparable from the condition of generating a good supply of steam in the locomotive boiler, it becomes important to partially remove this inconvenience when practicable; and as the state of the fire, and the quantity of steam required, are frequently varying, it may be positively assumed that an invariable contraction of the blast pipe is an imperfection.

It frequently occurs that there is either too much, or not enough steam in the boiler; when there is too much, it is the usual custom to open partially, and sometimes entirely, the fire door, so that by admitting a current of cold air into the fire box, and through the tubes, the production of steam will be

diminished, but this remedy is very objectionable, and should be applied as seldom as possible.

When there is not enough steam, the draught through the fire, in consequence of the low pressure of the steam, and the slow motion of the engine, will necessarily be less energetic than it ought to be, the means of exciting the fire becoming inefficient at the time when its assistance is most wanted. A good engineer will certainly take care that this occurs as seldom as possible, but there are accidental causes over which he has not sufficient control, and on such occasions the power of contracting the orifice of the blast pipe would be very beneficial, by enabling him materially to increase the rapidity with which the fire would be brought up to its proper state.



By good management, the engineer can therefore have full power over the production of steam, so as at all times to have a good supply, and to prevent almost entirely the loss occasioned by its escape from the safety valves while the engine is in motion; and taking into consideration the frequent occasions on which advantage may be derived by varying the orifice of the

blast pipe, it may be inferred that it is as requisite to have full command of this orifice, as it is to be able to determine the position of the regulator. The speed of the engine may, moreover, be occasionally regulated with advantage, by varying the orifice of the blast pipe, without altering the position of the steam regulator. To carry out, in a practical manner, the variable contraction of this orifice, it is requisite—That the apparatus should be easily constructed and applied, and not liable to get out of order; that its action should be simple and effective; that an indicator should show the area of the orifice under which the engine is working.

Having pointed out the general advantages I propose to derive from the application of a variable blast, I will now describe the apparatus that has been employed, which will be clearly understood, with the assistance of the annexed figures.

In the construction of this variable blast, there is one point on which it is proper here to make a remark, which if not attended to, would materially tend to destroy the good effect to be produced.

The annular space between the internal cone and the orifice of the blast pipe, if too much contracted, diminishes the energy of the blast; so that it is necessary that, at the point of greatest contraction, with a view to obtain the strongest draught, the relative diameter should be so calculated as to leave nearly a half of an inch of space, for the passage of the steam between the internal moveable cone and the edge of the blast pipe.

The intensity of the draught through the fire can be weakened, therefore, either by enlarging or by contracting the orifice of the blast pipe, beyond a certain limit. I have occasionally regulated the motion of an engine by the contraction of the blast pipe, leaving at the same time the regulator wide open, because by contracting the orifice more or less, the pressure behind the piston may be varied, and so regulated as to augment or diminish the effective action of the steam on the piston. The adoption of this variable blast may also be considered as an extra security, for by keeping the internal regulating cone of the blast pipe closed, while an engine is required to remain stationary, no danger could arise from the accidental opening of the regulator.

Explanation of Figures.—Fig. 1. Longitudinal elevation of a locomotive boiler, part of the smoke box being removed to show the extremity of the blast pipe. The circular portion of the boiler between A and L is omitted.

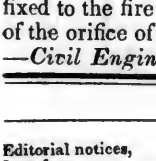


Fig. 2. Plan of the orifice of the blast pipe, showing the regulating internal cone B, with its three guide ribs *b*, *b*, *b*, upon an enlarged scale; A, smoke box; B, regulating cone of the variable blast; *b*, *b*, *b*, three thin ribs or feathers, attached to the regulating cone B, for the purpose of keeping the cone B exactly in the centre of the blast pipe; C, vertical rod, to which is attached the regulating cone; D, part of the chimney; E, blast pipe; F, hand gear to work the cone B; K, graduated plate fixed to the fire box, to show the position of the cone B, and the exact area of the orifice of the blast pipe; L, fire box. H. H. Edwards.

—*Civil Engineer and Architect's Journal.*

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AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 6, Vol. I. Third Series. | JUNE, 1843. | Whole No. 425, Vol. XVI.

We are indebed to a friend for the following clear and satisfactory explanation of the recent rupture of the boiler of the steamer Mohegan. It will be seen that the fault was not in the form, but in the construction of the boiler. Such accidents serve as useful lessons to the careful mechanic—by teaching the necessity of increasing the strength of the boiler in those portions which have hitherto been left comparatively weak.

EXPLOSION OF THE BOILER OF THE STEAMBOAT MOHEGAN.—APRIL, 1843.

The steamboat Mohegan, at the time of this explosion, was furnished with two copper multiflue or tubular boilers, two and a half years old, constructed after the plan of locomotive engine boilers, for railroads. The tubes, (260, or thereabouts, in number,) had a length of about eleven feet, with a diameter of about two and a half inches. One only, of the boilers burst. The rupture was in the flank of the outer cylinder or shell, partially underneath and nearly midway of the length of the tubes. It evidently commenced at an arm-hole, three by seven inches, in the side of the boiler. From this arm-hole a rent was made each way to the nearest seam or row of rivets, the portion separated hanging like a flap, of the width of a single sheet of copper, and forming an opening for the escape of hot water and steam, of about three square feet. The explosion was accompanied by a loud report, and the end of the boiler nearest the rupture, was raised some three feet from its bed. The circumstances attending this explosion do not appear to warrant the conclusion of its having been produced either by a deficiency in the supply of water, or from an undue pressure of the steam. The part which gave way, was low down in the boiler, and was not exposed either to the direct or indirect action of the heat, and could not therefore have been weakened from this cause, and had there been an extraordinary pressure of steam, the boiler, if properly constructed, would have yielded internally, as in all similar cases of locomotive boilers, by the rupture of one or more of the tubes, and the effect would also most likely have extended to the boiler, between which and the ruptured one there was a free communication.

The cause, therefore, for the bursting of the boiler was in all probability,

the want of a due degree of strength in the boiler itself, at the place of rupture. It is possible that this defect may have been in the copper. The sheet which gave way might have contained, perhaps, some flaw not discovered by the manufacturer. Supposing the material to be sound in all respects, still there were, in our view, mechanical defects in the structure of the boiler itself.

1st. The edge of the arm-hole was not protected from rupture by a band soldered and riveted thereto.

2d. The boiler rivets were too large, or too near together, by which, too much of the metal or substance of the copper was cut away.

3d. There were no stay-bars or bolts to support the sides or shell of the boiler, and no bands enclosing it.

This last circumstance is, we think, very conclusive as to the want of the requisite strength in the boiler. For the distance of eleven feet, the length of the tubes, no stay-bolts were inserted. The diameter of the shell of the boiler of this portion, is about eight feet. Its form cylindrical. With so great a diameter and length, the effect of the pressure of the steam acting with all the advantage of the funicular power in forcing out the sides of the boiler, it was scarcely possible that the copper should long be able to stand.

The locomotive boilers used upon railways are unquestionably the safest form of boilers, and for the very good reason that the shell is so much stronger than the tubes, that the latter under an undue pressure are always the first to yield, and as they are of small size the rupture of one or more is not attended with serious consequences. Each tube becomes in fact, a safety valve and the steam finds vent in a mode not likely to produce serious injury. The boiler of the Mohegan had less relative strength than a locomotive boiler, inasmuch as it was constructed of copper instead of iron, and of much greater magnitude. It is true that the former was designed to be worked with a less pressure of steam, but the difference in this respect was less than the difference in the absolute strength of the two descriptions of boilers.

A most important consideration in the construction of the tubular or multiflue boiler, is the giving to the exterior cylinder or shell a greater degree of strength than is possessed by the tubes. There is no difficulty in accomplishing this, even with boilers as large as those of the Mohegan. When so constructed, they are the safest form of boiler, and as they are not surpassed for effectiveness in generating steam, we hope that the case of the Mohegan will not be quoted to their prejudice, but serve rather to induce a more full investigation and thorough appreciation of their merits.

Fulton.

REPAIRS OF RAILWAYS.

All the first attempts at railways in the United States, as their defects of construction were developed in working them, were over and above that expense, put to heavy annual expenditures in correcting those defects, which

belonging more properly to construction, should have been charged to the capital in the road; but the whole appearing in *one item* under the head of ordinary repairs, has led to very exaggerated impressions as to the costliness of merely maintaining a railway, and which are yet indiscriminately entertained of the old and more modern structures, without considering that in the latter most of those original defects have been corrected, and that principally by a more liberal outlay in their first construction.

A case particularly illustrating this fact, is found in the Baltimore and Ohio railroad, among the earliest of these enterprizes, which after contending for several years with every difficulty, was nigh being abandoned in despair, and was only saved by Mr. M'Lane being called to preside over it in 1837, at which period he describes its condition in the following terms.

"The main stem to Harper's Ferry was in a state of utter delapidation, the moving power and machinery inadequate to the accommodation of the business actually offered for transportation. The department of repairs of the road was both expensive and inadequate, consisting of an unnecessary amount of superintendance without the requisite skill, and under large outlays, the road was annually becoming worse. All the repairs of machinery were made by others, under contracts at high prices, and so inadequately performed, that every part of the machinery was daily becoming more unfit for use. Public confidence appeared to be entirely withdrawn."

It is from its operations under this condition of things that most of the arguments have been drawn, and are to this day appealed to against the railway system in general. The report shows that from 1837 to 1842 the average annual expenditure in remodelling the road, was for those five years, $83,400, or $850 per mile, being $370 for labor, and $480 per mile for materials; and that now, although laboring under many miles of flat bar road, the expense for labor of adjustment and repairs of road, is reduced to $650 per mile per annum. Instead, therefore, of the above dark picture of 1837, we have now its condition in 1842, described by Mr. M'Lane in the following bright colors; and considering the disadvantages still, of this machine, in *heavy grades*, *short curves* and *flat rail*, its present success may be appealed to, as the *complete triumph* of the modern railway system in judicious hands and in suitable locations.

"Here is now a system of railroad operations reduced to a scale of greater cheapness and economy than any other known to us in Europe or the United States, and brought to its present perfection by nearly five years of arduous toil and the exercise of all the skill and science the company could employ. It is daily complying with all the demands of trade, and giving universal satisfaction to the public, with fewer interruptions, and at less cost of transportation, than any other known road."

The reports from several roads for a series of years, furnish the following rates per mile per annum, for adjustment and repair of road, but as no details are given, it is not known what proportion belongs to repairs and what to re-construction, and the average being struck on merely the distance be-

tween the two termini of the road, without counting the miles of sidings or double track, they cannot be fully relied upon as showing the *true amount of ordinary cost* of maintenance of road.

Boston and Lowell,	26	miles,	edge rail,	average pr. mile for	5 years,	$681
Boston & Providence,	41	"	"	"	5 "	367
Boston and Worcester,	45	"	"	"	5 "	501
Utica and Schenectady,	78	"	flat bar,	"	5 "	450
Georgia railroad,	100	"	"	"	5 "	240
Baltimore and Philad.	95	"	mixed rail,	"	3 "	500
Philad. and Reading,	56	"	edge rail,	"	2 "	300

The varying circumstances of the above roads, as to character of structure, soil, facility of drainage, prices of labor and materials, renders an average of them entirely futile, and shows the necessity of judging each road separately by its own merits and peculiarities.

To come, then, more strictly to the item of repairs and labor of adjusting track, let us look into the different constructions of road and show what is the whole cost of materials composing them; the entire consumption of these, *in a given time*, being of course the limit of the cost of these repairs, which fluctuating as to amount in the annual intervals, will result in the following average per mile for the whole period.

No. 1.

Ground sills 21,100 feet N. Car. pine per mile,	274			
Joint pieces 5,000 feet do.	65			
Sleepers 1,760 7 by 8 inch,	493—832	last 5 years,	loss per mile per annum,	166
Bridges, wooden portion, average cost per mile,	1,500	" 12 "	"	125
Iron rail, chairs and spikes,	4,000	" 25 "	wear 25 per cent per ann., or per mile,	40
				331
Labor of adjusting track and making repairs, per mile,				269—$600

No. 2.

Ground sills, per mile,	253			
Cross ties and joint pieces,	271			
Longitudinal string pieces, yellow pine,	316—840	last 5 years,	loss per mile per annum,	140
Bridges, wooden portion, average cost per mile,	2,500	" 12 "	"	208
Iron rail, chairs and spikes,	4,000	" 25 "	wear 25 per cent per ann., or ser mile,	40
				388
Labor of adjusting track and making repairs per mile,				312—$700

No. 3.

Oak sleepers on broken stone ceds 1,700 pr. m.,	510	last 7 years.,	loss pr. mile. pr. an.	73
Bridges, wooden portion, average per mile,	2,500—3,010	12 "	"	208
Iron rail, chairs and spikes,	4,000	25 "	wear 25 per cent per ann., or per mile,	40
				321
Labor of adjusting track and making repairs, per mile,				259—$580

In the above, we have the true principle by which to estimate the labor and repairs of a railway, the amount of which, will be governed, and vary according to the location and other peculiarities of each road.

The periods assigned above, as the duration of each item are about the averages determined by past experience. The nature and seasoned character of the woodwork, but more particularly the variableness of soil to be expected on a long line, all more or less affect its durability. In certain soils

the oak timber will be destroyed in 4 to 5 years, and in others, last 10 to 12 years, the average about 7 years. Pine wood on the ground decays in 5 to 6 years. Locust and cedar the most durable, are too costly to be commonly used. The *frame timbers* of the bridges first well seasoned and then painted, should last 20 years, the flooring beiug the portion most exposed to decay, and an average of 12 years duration for the whole, is not an over estimate. The *rolled iron rail* it is now well ascertained, after 15 years experience, when of *originally good mineral and well manufactured* that its renewal *costs little more* than the labor of replacement, at which rate its entire cost could not be expended under 25 to 30 years, and where with two tracks, it is used only in one direction, it may be said to be everlasting, under almost *any amount of business.*

The exemption from bridges on a railway is a great saving, first and last, but is rarely found at less than the amount in our estimate. The long Island railroad is, however, *peculiar*, in being without a single bridge, and on a straight line, for 100 miles. The amount of business on a railway will affect only in a small degree the expenditures for adjustment and repairs, the nature of this machine being, on the score of safety in particular, to exact as *good order* for a small, as for a large business, and once in order, it answers with but a trifling addition of expense as well for the passage over it of a dozen as of only one daily train; hence is its full economy only found under a large business, and the fact made more manifest, that it is the cheapest means of transport, in all cases, for passengers and light freight; and under favorable circumstances for all kinds of heavy freight, carried at a speed of about 10 miles per hour.

Thus has the railway structure been graduatly and *imperceptibly* acquiring strength and completeness in all its parts; and in none more than in its mainspriug, the locomotive, which is now made with a *vast increase* of power and efficiency, and with scarcely and more pressure on any single point of the road, than the cars it drags; so that as compared with its condition 10 years back, the *entire railway machine* is improved *one hundred fold;* and although the old data has thus been rendered obsolete, it is still commonly adduced against the railway system by the interested and uninformed, either entirely to condemn, or at least to show it up unfavorably in the comparison with canals.

The following cost of working English railways is taken from Professor Vignoles' lectures, and is useful as showing that our American railways are worked quite as economically.

	Per mile per train.	Lowest rate, cents.	Medium rate, cents.
Locomotive power,	"	25	32
Repairs of carriages,	"	6	8
Maintenance and repairs of road,	"	14	16
Conducting traffic and stations,	"	10	10
Rates, taxes, and government duty on passenger,	"	14	16
Police,	"	3	4
Management,	"	5	6
Miscellaneous expenses,	"	3	4
		80	80

This cost includes every thing save interest on loans and dividend on capital.

MAIN LINES OF RAILWAY FOR 1842.

The general impression is, that all our railways are actually sinking money, but this is not true of the principal main lines in various sections of our country, and still less so of many of the minor ones, which on the contrary are very profitable. The reports of the main lines for 1842, show an average yield of 5 per cent. on their entire cost in capital and loans, which for a period of such unparalleled stagnation, is doing very well; and as to their *indirect dividends* or saving to the public, (of which, however, it takes no note,) in transportation of person, merchandize and intelligence, it cannot be counted. Let us enumerate a few examples in round numbers.

	Name of road.		Miles.	Cost.	Nett rect.'42.	Pr.ct.
1	Philadelphia and Columbia,	edge rail,	82	$5,000,000	$200,000	4
2	Philadelphia and New York,	do.	87	7,000,000	400,000	5¾
3	Boston and Albany, (first year)	do.	200	9,600,000	385,000	4
4	Phila. and Baltimore,	mixed rail,	94	6,000,000	230,000	4
5	Balt. and Ohio, to H. Ferry,	do.	100	5,000,000	210,000	4¼
6	Albany to Buffalo,	flat rail,	322	7,000,000	640,000	9
7	Augusta to Madison, Ga.,	do.	147	2,400,000	135,000	5½
			1032	$42,000,000	$2,200,000	

In the above costs, are included all the extraneous burthens with which many of these roads are saddled, and against which nothing could sustain them but an extraordinary elasticity peculiar to this improvement, for which it has generally no credit. In the instances where the stock has been temporarily annihilated, as with the *Baltimore and Philadelphia*, by the necessity of the immediate return of the loans, the railway, as a fair money making concern in proper locations, should not be held responsible. These drawbacks are not the fault of the system but its misfortune, and will serve as warning beacons in all future projects of this kind.

ANNUAL REPORT OF THE COMMISSIONERS OF THE CANAL FUND, FOR 1842.

We have seldom seen so much useful information condensed into a small compass, as we find in this document. Unlike most productions of the kind, it is clearly and methodically arranged, giving the result of great research in such a comprehensive form, that every reader may verify for himself the important conclusions drawn by the commissioners. Where all is so concise it would be useless to endeavor to form an abstract; we shall therefore content ourselves with giving such of the tables and statements as are of most general interest.

" The amount of toll received on each canal during the season of navigation in 1842, is as follows:

Erie canal,	$1,568,946 56
Champlain canal,	95,957 54
Oswego "	31,222 19
Cayuga and Seneca canal,	16,948 16
Chemung canal,	7,702 05
Crooked lake canal,	989 39
Chenango "	13,615 38
Genesee Valley "	13,204 11
Oneida lake "	462 63
Seneca river towing path,	149 51
	$1,749,197 52

" There is a diminution in the tolls compared with the year 1841 of $285,-685. Of this diminution, $130,921, or 45 83-100 per cent, is on descending, and 154,754, or 54 17-100 per cent is on ascending freight.

The total tons of all descriptions of property which moved on the canals is shown to be $1,236,931, and the total value of the same property $60,-016,608."

The most valuable part of this report is to be found in a series of comparative tables from which we shall make several extracts:

The total tonnage of all the property transported on the canals, ascending and descending, its value, and the amount of the tolls collected for the six years preceding, is as follows, viz:

Year.	Tons.	Value.	Tolls.
1836,	1,310,807	$67,634,343	$1,614,342 46
1837,	1,171,296	55,809,288	1,292,623 38
1838,	1,333,011	65,746,559	1,590,911 07
1839,	1,435,713	73,399,764	1,616,382 02
1840,	1,416,046	66,303,892	1,775,747 57
1841,	1,521,661	92,202,929	2,034,882 82
1842,	1,236,931	60,016,608	1,749,196 00

The total tons coming to tide water, for each of the last nine years, and the aggregate value thereof in market, were as follows, viz:

Year.	Tons.	Value.
1834,	553,596	$13,405,022 00
1835,	753,191	20,525,446 00
1836,	696,347	26,932,470 00
1837,	611,781	21,822,354 00
1838,	640,481	23,038,510 00
1839,	602,128	20,163,199 00
1840,	669,012	23,213,573 00
1841,	774,334	27,225,322 00
1842,	666,626	22,751,013 00

The quantity of wheat and flour that came to the Hudson river rapidly rose to a maximum in 1840, since which year there has been a decrease.

The tonnage from tide water in 1842 was 123,294, the larger portion of which was merchandize.

" There is a decrease of merchandize going up the canals of 38,628 tons, and a decrease in the quantity of other articles of 793 tons, making a total decrease in the ascending tons, comparing 1841 with 1842, of 39,421 tons.

The tons coming to tide water have decreased 107,708, comparing the present with the preceding year."

Of the merchandize cleared at Albany, West Troy, and Schenectady, (94,212 tons)—about 60 per cent was left at the Erie canal, 11 per cent on the Champlain canal, 10 per cent on the Oswego canal, 7 per cent on the Cayuga and Seneca canal, and the rest on the other canals, from 1 to 3 per cent each.

WESTERN TRADE.

The products of other States coming by way of Buffalo, have rapidly increased in amount—being in 1842, 179,437 tons, nearly the same as for

1841—of these the agricultural products and miscellaneous articles have constantly increased, while the products of the forest and manufactures have slightly decreased since 1841.

The same proportion holds in regard to the tonnage from other States by way of Oswego—the amount however being but 9,217 for the last year.

STATE OF TONNAGE AND BUSINESS OF THE CANALS.

"The tonnage of the canals, whether in boats or rafts, having reference to its source, naturally falls under the following five general heads of clasification:

1st. The products of the forest; 2d. Agriculture; 3d. Manufactures; 4th. Merchandize; 5th. Other articles.

It is in reference to this division of the commerce of the canals, that the following statements have been made out.

The commissioners have thought it not without interest to institute a comparison for a series of years of the tons, value and tolls of each head of transportation above given, in view of ascertaining the increase or diminution of the tons, value or tolls of the total movement. To this end, sundry statements have been compiled from the reports, corresponding to this, which have annually been made to the legislature for a series of years."

The tons classified as above of the *total movement* on all the canals from 1836 to 1842, is as follows:

Year.	Products of the forest.	Agriculture.	Manufactures.	Merchandize.	Other articles.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1836,	755,252	225,747	88,810	127,895	113,103	1,310,807
1837,	618,741	208,043	81,735	94,777	168,000	1,171,296
1838,	665,089	255,227	101,526	124,290	186,879	1,333,011
1839,	667,581	266,052	111,968	132,286	257,826	1,435,713
1840,	587,647	393,780	100,367	112,021	222,231	1,416,046
1841,	645,548	391,905	127,896	141,054	215,258	1,521,661
1842,	504,597	401,276	98,968	101,446	130,644	1,236,931
Total 7 years,	4,444,455	2,142,030	711,270	833,769	1,293,941	9,425,465
Yearly av. 7 ys.	634,922	306,004	101,610	119,109	184,848	1,346,495
Pr.ct. each class,	47·15	22·72	7·55	8·85	13·73	100
An. av. 1836 to 1839, 4 years,	676,666	238,767	96,010	119,812	181,452	1,312,707
An. av. 1840 to 1842, 3 years,	597,264	395,654	109,077	118,174	189,377	1,391,546

Under the head of other articles are found chiefly stone, lime and clay—the larger part of which were for the constructions on the canal, as the decrease during the past year will indicate—beside these, gypsum and coal make up nearly the whole amount. The quantity of coal appears to be steadily increasing. From this table it will be seen that the annual average of the total *movement* obtained by comparing the last three with the preceding three years, increases two per cent per annum. This increase is the result of the increase of Agriculture, Manufactures and Sundries, over the decrease of the products of the Forest and Merchandize.

The tolls paid on the "total movement" of articles, and upon boats and

passengers, annually from 1837 to 1842, both years inclusive, are as follows:

Year.	Boats and passengers.	Products of the forest.	Agriculture.	Manufactures.	Merchandize.	Other articles.	Total.
	Dollars.	*Dollars.*	*Dollars.*	*Dolls.*	*Dollars.*	*Dolls.*	*Dollars.*
1837,	195,508	211,118	370,041	75,507	380,826	56,430	1,289,430
1838,	210,457	229,998	468,495	74,941	526,911	78,555	1,589,357
1839,	181,323	253,710	479,534	81,251	535,486	83,662	1,614,966
1840,	185,022	197,904	808,623	75,765	427,966	80,467	1,775,747
1841,	179,819	313,444	785,943	95,595	558,003	102,078	2,034,882
1842,	165,515	211,979	805,376	70,611	393,875	101,840	1,749,196
Total for 6 years,	1,117,644	1,418,513	3,718,012	473,670	2,823,067	503,032	10,053,578
Yearly average,	186,274	236,359	619,669	78,945	470,511	83,838	1,675,596
Per cent.,	11·12	14·11	36·98	4·71	28·08	5·00	100
Average from 1837 to 1839 both inclusive,	195,763	231,609	439,356	77,233	481,074	72,882	1,497,917
Average from 1840 to 1842 both inclusive,	176,785	241,109	799,981	80,657	459,948	94,795	1,853,275

Comparing the tolls for the same two periods of three years each—it will be found that the decrease is only on boats, passengers, and merchandize.

" Thus it appears that, comparing the last three with the previous three years, while the average annual increase of the tolls is 7 per cent, the average annual increase of the total movement of tonnage, or of the matter which fills up the canals, is only 2 per cent. The reason for this is found in the fact that the forest, which for the last seven years has furnished 47 per cent of the tonnage, has contributed about 14 per cent of the tolls, and that agriculture, which has furnished but about 22 per cent of the tonnage, contributes now nearly 50 per cent of the tolls, and that while the tonnage of the

forest decreases 2, that of agriculture increases 3. The reason for the small increase in the *tolls* on the products of the forest, while there is a decrease in the *tons*, may be that a less number of tons was transported a greater number of miles, the natural consequence of a supply which must continue in every locality to be in an inverse ratio to the demand. The diminution of about $20,000 in the tolls on "boats and passengers," is mainly, if not wholly on passengers alone, the toll on the passengers having been reduced in 1841 from two mills per mile to one mill per mile on each person carried on board of packet or freight boats."

From a table giving the tonnage of each class of articles coming to the Hudson river, the following information is derived.

"Of this tonnage, the forest furnishes about 60 and agriculture about 31½ per cent., in all about 91½ per cent; that the forest decreases and agriculture increases in nearly the same proportion, keeping the tonnage just about stationary, the annual average of the last four years, being 675,-449 tons, and the annual average of the last eight years being but 676,736 tons."

The course of the tonnage between Utica and Albany is shown by the lockages at Alexander's lock—the first west of Schenectady. The increase of the annual average of these for the four last over the four preceding years is 1,519, equal to a gain of 1 53-100 per cent. per annum.

Estimating the business of this, the main thoroughfare of the Erie canal, by the boats clearing from and arriving at Albany and Troy, it is found that the annual average for the last five years is 956 less than for the five preceding, being a decrease of 59-100 of one per cent per annum for the last five years. Notwithstanding this decrease it is stated that a large portion of the lockages in 1829, 1840, 1841, were consequent upon the enlargement of the canal, being for stone and other materials for the works between Utica and Schenectady.

"One ton of the products of agriculture pay more than four times as much toll as one ton of the products of the forest. The tons of the products of the forest which came to tide water in 1842, were 321,480, or about one-half the tonnage which came to tide water. If hereafter none of the products of the forest should reach tide water, and its place should be supplied by only 80,000 tons of the products of agriculture, the canal might lose nothing in tolls, and would get rid of 240,000 tons, or more than one-third of the tonnage arriving at tide water. Thus it will be seen that the tonnage may very sensibly diminish and the tolls may, at the same time, and at the present rates, increase."

From the internal demand of the State for bread stuffs, it is estimated that the surplus arriving at tide water, of the *growth of this State*, will little if any exceed that of past years.

"Thus it is comparing 1836 with 1842, that while the increased delivery at tide water of flour and wheat, is about 75,000 tons, the increase from western States is about 100,000 tons. It will be seen also that the products of this State, and the delivery at tide water in 1840, exceed that of either of the two subsequent years, while the product of western States steadily increases."

The results of a table of lockages at seven different points, confirm the evidence before given.

"At every point west of Utica, the lockages seem to have been less in the last year, than in 1835 or 1836.

It is seen that at Alexander's lock, three miles west of Schenectady, the lockages in 1841 were over 30,000 with a single lock, while at Black Rock and at Lockport, they were less than 12,000 last year, and at the Syracuse lock, (east of Syracuse, and taking the tonnage from the Oswego canal,) 19,397, and at each place less than in 1836.

Similar results are shown on the Champlain canal, in the years 1835, 1836, 1837 and 1838, since which latter year the lockages have not been obtained."

The number of miles run upon the canals by all the boats is ascertained exactly by the boat tolls. The miles run by freight boats were greatest in 1838 and 1841—those run by packet boats decreased from 1837 to 1840, and have since increased. The annual average of the whole for the last three years, has increased 530,097 or 276-100 per cent per annum."

The conclusion we give in the words of the document as being too important to admit of curtailment.

"The foregoing detailed evidences of the trade and tonnage of the canals, are the results of a system of statistical returns by the collectors of tolls, put in operation in 1836, and continued to the present time. A recapitulation of the results to which a careful examination of these evidences has led, are as follows:

1. *Total movements, in tons, on all the canals.*

Comparing the last three with the previous four years, the increase is 2 13-100 per cent per annum.

2. *Total movement of boats, in miles, on all the canals.*

Comparing the past three years with the previous three, the increase is 2 76-100 per cent per annum.

3. *Tons arriving at tide water.*

Comparing the last four with the previous four years, the increase is 11-100 of one per cent per annum.

4. *Boats arriving at tide water.*

Comparing the past five with the previous five years, there is a *decrease* of 59-100 of one per cent per annum.

5. *Lockages at the lock three miles west of Schenectady, called Alexander's lock.*

Comparing the last four with the previous four years, the increase is 1 53-100 per cent per annum.

6. *Tons of merchandize ascending the canals.*

Comparing the last four with the previous four years, the increase is 1 42-100 per cent per annum.

These, it will be observed, are six separate and distinct tests of the condition of the trade and tonnage of the canal in the last three, four and five years, as compared in each case with the previous three, four and five years.

Tests numbers 1 and 2, relate to the *total movement* of all matter on all the canals to and fro, whether coming to tide water or not, both showing an increase of over two, and less than three per cent per annum.

Tests 3, 4, 5, and 6 relate only to the property arriving at and going from tide water, showing an increase in the tons of arrival, of only 11-100

of one per cent per annum, and a *decrease* in the arrival of boats of 59-100 per cent per annum.

The lockages at Alexander's lock, as has been before observed, were doubtless increased in 1839, '40 and '41, by the temporary transportation of stone for the enlarged locks.

But while there has been less than 3 per cent average annual increase in the *total movement* on the canals in the last three years, and only 11-100 of one per cent increase in tons, arriving at tide water, there has, in the same time been an average annual increase of over 7 per cent per annum in the tolls received on all the canals.

The increase of over two per cent in the total movement on all the canals, is not only reconcilable with the stationary condition of the tonnage arriving at the Hudson, but is in perfect harmony with it. The increase of population in the interior, while it contributes to the internal trade of the canals, by an exchange of commodities between different sections of the country, at the same time creates a demand for those bulky products of the forest, and those products of agriculture, which, at an earlier period and with a sparser population, are sent to the sea board.

The relative proportions which the tons of the different classes of articles arriving at tide water in the last eight years bear to each other, are as follows:

	Per cent.
Products of the forest,	60 39
Agriculture,	31 54
Manufactures,	1 69
Merchandize,	09
Other articles,	6 29
Total,	100 00

It has been shown that the increase in tons of agriculture arriving at tide water just about keeps pace with the decrease, in tons, of the forest, and that as those two sources furnish about 92 per cent of the tonnage, the average delivery at tide water for the last four years has been about stationary.

It has also been shown that the increased delivery at tide water of wheat and flour is but just about equal to the increase of those staples from the western States by the way of Buffalo and Oswego, thus showing that the surplus production of our own State is stationary.

The commissioners are not prepared to say that the results of the last four or five years, as compared with an equal number of previous years, are to be taken as a sure indication of the future. The evidences of the comparative condition of the trade and tonnage of the canals are given as they find them in an authentic shape. They are the only *facts* on record—the *only basis* of an estimate for the future. Resting upon the results and assuming as it is safe to do, until the results of other years are obtained, that they are correct indices of the future, the commissioners are led to the following conclusions:

1. That owing to the diminution of the forest, the tonnage arriving at tide water, over the most crowded portion of the canal, has nearly if not quite reached its maximum.

2. That owing to the decrease of the forest and to the practice of carrying larger cargoes than formerly, the arrival of boats at the Hudson river, which has *decreased* one half of one per cent per annum in the last five years, is not for a long time to exceed the average of those years, which have been accommodated by a single lock.

3. That as 30,000 lockages can be made in a season of navigation by a

single lock, as has been tested at Alexander's lock, through which the tonnage arriving at tide water on the Erie canal passes—as the largest lockage at any one lock west of Utica, is at the Syracuse lock, which has been as follows:

In 1835,	22,258
1836,	21,692
1837,	18,181
1838,	20,383
1842,	19,397

As the lockages at the Lockport locks have been as follows:

In 1835,	10,925
1836,	13,808
1837,	10,041
1842,	11,697

There is reason to suppose that the internal trade of the canals will never task the capacity of single locks.

4. That owing to a change in the character of the tonnage, from the products of the forest to the products of agriculture, which, without increasing the arrival of tons at tide water, has in the last four years, added an average of $355,000 to the tolls; there may, for the same reason, be a further average addition to the tolls, without any increase of tonnage.

The information thus accumulated is of the utmost value to this State—showing as it does, that while the *demands upon the capacity* of the canal are on the decrease, the *revenue* to the State is on the increase. Could the knowledge of these facts have been anticipated a few years since, we may safely say that millions would have been saved. It is not yet too late to profit by it—and we only hope that a continuance of the research manifested in this paper, may in future years be made available for the public benefit.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.—SECOND COURSE.—LECTURE XVII, AND LAST.

Before proceeding to a summary of the second course, Mr. Vignoles observed, that there was a material point connected with the subject which had not been sufficiently discussed—viz. the motive power to be employed; on this greatly depended the principles on which a line of railway should be laid out, the end and object being to convey the greatest extent of traffic at the least cost; this cost was compounded—first, of the interest of the capital expended, which should be considered a constant charge; and second, of the periodical working expenses—the work to be done being summed up in the general expression of "overcoming all obstacles to facility of motion." What are these obstacles? They might be divided into two great heads—Gravity and Friction. 1st. Gravity is a natural cause existing under all circumstances, and affecting lines deviating from the horizontal, in direct proportion to the sine of the angle of inclination. Engineers, therefore, have considered that the first principle in laying out roads, should be (under limits) to approximate as nearly as possible to the horizontal, in order to exclude one of the great causes of obstacle; since, with maximum loads, the retardation arising from gravity is most felt. When such could not be effected, then to distribute the total rise (or effect of gravity) along the easiest ratio of slope. But, in practice, the occurrence of maximum loads, in ordinary passengers and merchandize traffic, forms the exception, instead of constituting the rule, and it is only when a regular and constant heavy trade is

to be anticipated that horizontal communications should be insisted on. 2nd. Friction is a physical cause, varying according to the perfection of the road and of the vehicles moving on it. In the practical working of a railway, however, so many expenses arise under the heads of "conducting traffic, management, etc." common to most lines, whatever the gradient, that they tend to make the cost of overcoming friction and even gravity (particularly with the ordinary light loads) but a small fraction of the total charges. Comparing the amount of obstacles on a railway with that on the ordinary road (where the friction, meaning thereby axletree friction and surface resistance, may be called sixteen to twenty times greater than on a railway,) and assuming the inclination on railway and road to be the same, the general result is that the perfection of the railway surface moved over, and the improvement of carriages, or rather that of their wheels and axles, cause the effect of gravity to be felt in the most sensible degree on railways; while the imperfection of the road causes it to be comparatively scarcely appreciated. Hence with the wretched surfaces of the old roads, and the clumsy wheels of our primitive vehicles, the hills seems to have scarcely added to the obstacles to be overcome. As the road surfaces and carriages improved, and increased speed and heavier loads were introduced, the necessity for the greater perfection of the ordinary road became apparent, and the remedy was applied in various degrees during the last **100** years until it was completed as far as possible, in the extensive improvements by Telford and Macneill on our great highways. But in carrying out this principle on railways we have run into the opposite extreme. We should first take in one sum the retarding causes of gravity and friction—viz: the friction, being constant, or nearly so, putting aside the resistance of the air at high velocities, varying only in the perfection of the wheel axles, and in the mode of lubricating, (the surface resistance on railways being, practically speaking, nothing,) and the maximum gradient, or rather the gravity due to it:—their sum will be the constant divisor for the motive-power, of whatever description that motive-power might be; and, in considering the latter point, it must be the distribution of the traffic, or what may be called the average hourly load throughout the year which is to determine the question. In many instances, in this point of view, it would probably often be found most economical to use animal power, (as is done on the Edinburgh and Dalkeith railway,) were not velocity required—which, on railways, enters so materially into the calculation, that mechanical power in some shape becomes necessary; and this divides itself into stationary power, or when too mechanical means are fixed. and locomotive power, or when the machine travels along with the load. There are two serious difficulties connected with the latter system; first, a great addition to the load, equivalent to the average of doubling it; and next, that the fulcrum through which the motive power must be transmitted —that is, the rail on which the locomotive driving wheel impinges—is greatly affected by atmospheric causes, occasioning great variation in the adhesion, and consequent uncertainty from slipping of the wheel, so that, as explained in a former lecture, the load after a locomotive engine is really limited by its adhesive power, and not, as first might be supposed, either by the cylinder power or boiler power. Considered abstractedly, stationary power is cheaper and always would be so if the traffic were certain and regular, with maximum loads and very moderate speed, even with the present obstacles of ropes, sheaves, and all their contingent complicated apparatus; but at high speed, with a great length of rope, the experience of the working of the Blackwall railway has shown that for passenger trains only, there was, compared with the most expensively worked lines on the locomotive system, to say the least,

no economy in the motive power, though other conveniencies arising from the peculiar arrangements on that line, were, perhaps, in this special case, more than equivalent. A most serious obstacle to stationary power, was the necessity of absolutely stopping, and disengaging and refixing, the trains at each station, which stations could not be conveniently, and certainly not economically, placed further apart than three to five miles, for it could readily be proved, that on a continued distance of six or seven miles of railway worked by a rope, the power of the largest engine that could well be erected, would be absorbed in moving the rope only. The Professor then went largely into a consideration of applying stationary engines as the motive power in working inclined planes under a variety of circumstances, and recommended to the students to consult the valuable work of Mr. Nicholas Wood on this subject, and indeed on all the details of railway working, of which, particularly in the third edition, there was most of the latest information. In many situations, however, where water power could be obtained, the stationary rope and pulley system might be advantageously introduced. Gravity became the motive power, on what were called self-acting inclined planes; that is, when the gravity of a descending train of laden carriages brought up a train of others empty or partially laden; or where skeleton wagons, or water tanks on wheels, could be useful as artificial counterbalancing weights in either direction alternately; the circumstances under which self-acting inclined planes could be properly introduced were rare. Mr. Vignoles then gave a clear account of various modes of working self-acting inclined planes; among these was described a curious and interesting one near the great limestone quarries in North Staffordshire; another on the St. Helen's and Runcorn Gap railway, which he had himself put up, and also the planes for the Great Portage railway, across the Allegheny Mountains, in the United States of America. Stationary power might also be used to a greater extent on the atmospheric system, whereby, to speak metaphorically, a rope of air was substituted for a rope of hemp or wire, and where no pullies were required, nor any necessary stoppage at the intermediate engines, where only the carriages had to be moved, and where nearly the whole dynamic force generated was made available for motive power. This system had already been explained to the class, and practically illustrated on a railway thus worked, and need not be further alluded to. The Professor was preparing for publication a separate lecture "On the Atmospheric Railway System," to be illustrated with plates, and tables, and appendices, in which that interesting subject would be fully gone into, and all the mathematical and philosophical investigations given, with estimates of the cost of such railways under various circumstances of traffic and gradient; fully enabling the value of the principle as a motive power, to be appreciated. Although modern practice had almost discarded the use of animal power from railways, it might be proper to refer cursorily to it. A horse seems adapted to drag vehicles, from the mode in which he adopts his muscular action, so as to throw the greatest effect on the line of draft; in making an effort to draw a carriage, the body of the animal is bent forward, throwing upon the latter the part of its weight necessary to overcome the resistance, the muscular force of the legs being employed in keeping up his traction and moving the body onward; the effort of the animal being revolvable into these two parts —viz. the action on the load, and that required to move itself by. It may be gathered from writers on this subject that the force a horse is capable of exerting, is that equal to about one-seventh or one-eighth part of his own weight: or that, on an ascent of one in seven or one in eight, the exertion required to overcome his own gravity, is a force equal to that he is able

to exert on a road on a level plane. Taking the average weight of a horse, and considering that he is capable of occasionally exerting great extra power on the load, still it seems to be satisfactorily ascertained, that nearly seven parts out of eight of the muscular power of a horse is required to drag his own weight forward, leaving, of course, only one part applicable to the load. But the criterion of a horse's power in practice is not the occasional effort of which the animal is capable at a dead pull, or for a short period: we must estimate his strength by what he can do daily, and day after day for a long period, and without breaking him down prematurely. If a horse is to travel at the rate of ten miles an hour his power of pulling is greatly diminished, and he can work only an hour or so in the day: at two miles an hour he may give out a power of 150 lb. on the load: at ten miles he has scarcely 35 lb. to spare, and at 12 miles an hour he can seldom be expected to do more than move himself. This was on the average of horses—all beyond were exceptions. Thus, the application of horses to railways as the motive-power was very limited: and in laying out lines where they are to be used, to full effect, gravity should be arranged to be always with the load, or, at least, not against it; the rate of travelling only 2 or 2½ miles per hour, and the traffic uniform. Mr. Vignoles proceeded to an interesting comparison between locomotive and stationary power up inclined planes, taking the inclination of 1 in 50 as a medium, and showed that *when the traffic was small and the loads consequently comparatively light, and the daily number of trains not great, locomotive engines*, as the motive-power, (taking into consideration all circumstances of first cost, and working expenses—particularly the latter, of which the locomotive power was but a small part,) *would not be so expensive as stationary engines*, while they would be certainly more convenient; and that, with all the best modern improvements in the locomotive engines, the system of working with large cylinders, using the steam expansively on the level and falling parts of the railway, improved boilers, etc., *planes of* 1 *in* 50 *might be practically worked;* the only material drawback being, occasional slipping of the wheels on the ascent, and the necessity of great caution and careful application of the brakes on descents; but on the whole, the balance, *under the above circumstances*, was much in favor of the locomotive system. The Professor then entered into a very long and minute comparison of the present system of working the Blackwall railway by stationary engines, with ropes and pullies, with what would be the case if the motive power were locomotive engines—and by tables, showed that while the working of the Blackwall Railway (3½ miles) on the stationary system, was costing about *seventy-two pence* per mile per train, the cost of working the Greenwich railway (3¾ miles) was only about *forty pence:*—but, Mr. Vignoles admitted, that by the former, great accommodation to the public was afforded by the numerous intermediate stations, while on the latter, there was only one stoppage. In concluding the general comparison between the two principles of mechanical motive-power, the Professor observed that on the locomotive system, a minimum of power need only be provided in the first instance and the number of engines might be increased gradually as the traffic required, which was a great consideration when the first expenditure of capital had to be kept down to the very lowest terms, at all future risks. On the stationary system, provision had been made from the outset, for the maximum anticipated trade, which of course increased the first outlay on the railway establishment, and depended on the ultimate economy of future working to make up the difference. Having concluded the notice of various descriptions of *motive-power* employed on railways, of which the preceding is but a mere

outline, some general remarks were made on the principles of laying out railways, in reference to the several systems respectively.

In a concluding general summary, Mr. Vignoles observed, that in his first course, at the latter end of 1841, he had fully considered the practical rules for earthwork and constructions:—these were not peculiar to railways; the theory and practice of bridge-building, applied to all internal communication, and would be most conviently considered in a separate illustrated course, but he wished to recall to the class generally, that in proceeding to lay out railways in the first instance, the engineer ought to enter much more deliberately into these previous inquiries, so absolutely necessary, than had hitherto been done. A system of applying the same general rule of perfect gradients alike to lines, of the least as well as of the greatest traffic, had too much prevailed, and until more rational ideas were substituted, the public would shrink from embarking in enterprises subject to all the contingencies of extra cost beyond estimates which had characterised almost every railway in this country. *The earthwork and its consequences*, regulated the cost, particularly as regarded contingencies, and the utmost consideration should be bestowed as to how far it was justifiable to encounter the expense of these operations. The average cost of earthwork, and all consequent works of art, etc., on the English railways was nearly £15,000 per mile, or about 50 per cent of the whole capital expenditure. Mr. Vignoles was decidedly of opinion that in *all future lines in this country, and particularly on the continent*, the correspondent outlay *ought not to exceed* £5000 *per mile*, and that beyond that sum perfection of gradient would be bought too dearly. In reference to the *gauge* of railways, Mr. Vignoles stated distinctly, that theoretical investigations and practical results led him to consider a six foot gauge the best; but the present 4¾ foot gauge was certainly rather cheaper. In respect of *curves*, he observed, that they were much less disadvantageous than had been first supposed: that a half mile radius is now everywhere admitted; and that he himself did not hesitate to adopt a quarter mile radius whenever expense could be materially saved; and if the atmospheric system of motive power should be found to succeed on a large scale, the curves might, on lines thus worked, be safely made still sharper. In regard to the systems of constructing the *upper works*, he had in a recent lecture, entered so fully into the comparison, that he need only now say, that if the expensive and complicated system of heavy rails and chairs, and cross sleepers, were preferred by engineers, then the ingenius improvements of Mr. May, of Ipswich, in chairs and fastenings, applied by Mr. Cubitt on the South Eastern (Dover) railway, with great care in laying, draining, and ballasting, made *that system* perfect and complete. The Professor, however, decidedly gave the preference to the less costly, and the more simple system of lighter rails, without chairs, laid on continuous longitudinal balks of timber of sufficient scantling and fastened on Evans's principle, modified in the manner shown by the models exhibited to the class; and several engineers were adopting this opinion. On the continent of Europe, where iron was dear, and timber cheap and abundant, Mr. Vignoles calculated *a saving of full* £2000 *per mile of double road would accrue from the adoption of the latter system*—which afforded a vast national economy. In reference to the subject of working drawings, plans, and sections, the Professor reminded the class of the importance he attached to having all such previously made out on a large scale, that the cubic quantities might be accurately obtained, and the just prices considered; and thus, in proceeding to make the estimates, nothing would be left to conjecture, and as little as possible left to be afterwards altered. The period of time for the execution

of the works should be extended as far as consistently could be done. The two great sources of the extra expenditure on railways had been, the extreme haste with which the work had been pushed on, and the changes of every kind from the original designs. These points being all carefully considered, *even before the plan was brought before the public in general*, the estimates might be better depended on. Mr. Vignoles then went through all the great items of expenditure generally arising on first construction, and explained how the accounts of measurements should be made out and kept under very distinct general heads, subdivided into minor items, from the purchase of the land to the last finish to the stations, and the entire fitting up and furnishing of the carrying establishments. Sufficient experience had been attained in all these matters to enable the engineer, in future, if the above rules were faithfully followed out, to place himself beyond all chances of reproach for making erroneous estimates. In conclusion, the Professor observed, that he had selected railways at the request of the class, as the theme for the course just concluded; but although so much consideration had been given to the subject, he had only been able to touch in a very general way upon the chief points; yet it was to be hoped a sufficient idea had been given of the principles of construction, and of their general application, to create an interest in their minds. Should any of the students hereafter be employed to execute a railway, he trusted they would recollect these lectures with advantage, while they would also probably better understand and appreciate them: at the same time, he must not neglect to impress upon them, that it was not at the college, in the lecture-room, or even in the office of an engineer, that all the duties and knowledge necessary could be taught: the young aspirant must pass much time in the work-shop, indeed, he must become a workman, and acquire the use and skill in the handling of tools, and the erection of mechanism of every kind—and passing to the actual works, ought to learn to be able to direct personally the labor of the mason, the carpenter, and the smith. "Above all," said Mr. Vignoles, "the student in engineering must carry into life with him the constant remembrance of what I have so repeatedly enforced, that the reputation of an engineer in this country is based upon the success of his works, of his mechanism, and of all the efforts of his mind and hand, in respect to, and in proportion to their being productive of commercial and beneficial results, to those who, at his suggestion, may undertake to provide the necessary funds: and he should consider how this result can be best obtained, rather than study the splendor of his undertakings. It is for the architect to attend to the decorative and the beautiful; it is sufficient for the engineer to study proportions, and rely on the simple grandeur of his works as a whole. It is related that Napoleon once observed to the celebrated Carnot, "*Les ingenieurs doivent toujours avoir des dees magnifiques;*" this is true as to their first conceptions, but in the realization, they must be sobered down by the rules of economy and judgment. After the first burst of talent, after image and form has been given by the hand to the bright idea emanating from the brain, let it be brought out to practical application only after a strict inquiry into the cost. Remember what I quoted on a former occasion, when contrasting the two celebrated light houses, the *Eddystone Cordouan*—no unfit emblem of the two celebrated engineers who erected them may I venture to add of their respective nations—remember, I say, "'*tis use alone that sanctifies expense.*"

REPORT OF THE PATENT COMMISSIONER.

We give the Patent Office Report entire in this number—but the docu-

ment as presented to Congress contains a vast amount of information relative to the products of our country, and will furnish us with several themes upon which to discourse in future numbers.

PATENT OFFICE, January, 1843.

SIR: In compliance with the law of Congress, the Commissioner of Patents has the honor to submit his annual report.

Five hundred and seventeen patents have been issued during the year 1842, including *thirteen* re-issues, and *fifteen* additional improvements to former patents, of which classified and alphabetical lists are annexed, (marked B and C.)

During the same period three hundred and fifty-two patents have expired, as per list marked D.

The applications for patents during the year past amount to *seven hundred and sixty-one*, and the number of caveats filed was *two hundred and ninety-one.*

The receipts of the office for 1842 amount to $35,790 96, from which $8,068 95 may be repaid on applications withdrawn, as per statement E.

The ordinary expenses of the Patent Office for the past year, including payments for the library and for agricultural statistics, have been 23,154-48, leaving a nett balance of $5,264 20, to be credited to the patent fund, as per statement marked F.

The above expenditures do not include those incurred within the last year for the recovery of the stolen jewels.

For the restoration of models, records and drawings, under the act of March 3, 1837, $14,060 02 have been expended, as per statement G.

The whole number of patents issued by the United States, previous to January 1843, was *twelve thousand nine hundred and ninety-two.* The continuance of the depression of the money market, and the almost universal prostration of all business, operates very disadvantageously on the receipts of this office, as many hundred applications are delayed solely from the want of funds or difficulty of remittance. The patents granted for the year, however, exceed those of the year previous by *twenty*, though there have been less applications by *eighty-six.*

The Digest of Patents, continued and brought down to January, 1842, has been printed, and 700 copies distributed to the respective States, and 200 copies deposited in the library, in compliance with the resolution of Congress directing the same.

The accommodations granted during the last year for the reception of the articles received through the exploring expedition, intrusted to the National Institute, must seriously thwart, if not suspend, the design of Congress in the reorganization of the Patent Office, which enacts, section 20, act of July 4, 1836, "that it shall be the duty of the commissioner to cause to be classified and arranged in such rooms and galleries as may be provided for that purpose, in suitable cases, when necessary for their preservation, and in such a manner as shall be conducive to a beneficial and favorable display thereof, the models, and specimens of composition and fabrics, and other manufactures of work and art, patented or unpatented, which have been or shall hereafter be deposited in the said office.

While the annual receipts of the Patent Office above the expenditures are sufficient to carry out fully the benevolent object of the National Legislature, the want of room of which it is thus deprived will be, for a time, an insurmountable obstacle, as all the rooms in the gallery could be advantageously used either by the Patent Office or the National Institute. No

remedy, therefore, remains, but an extension of the building, which might be done by the erection of a wing sufficiently large to accommodate the Patent Office on the first story. The building can also afford room for lectures by professors, should they be appointed under the Smithsonian bequest; and may I be permitted here to observe, that a gratuitous course of lectures in the different branches of science would certainly do much to diffuse knowledge among men. I can confidently say that the agricultural class look forward with bright anticipations to some benefit from the Smithsonian bequest, and to the time when the sons of agriculturists, after years of toil at the plough, can attend a course of lectures at the seat of government, and there learn, not only the forms of legislation, but acquire such a knowledge of chemistry and the arts as will enable them to analyze the different soils, and apply agricultural chemistry to the greatest effect. Such encouragement will, indeed, stimulate them to excel in their profession, while others, deemed by many more favorable, are indulged with a collegiate course of education. Little, indeed, has been done for husbandry by the General Government; and, since eighty per cent of the population are more or less engaged in this pursuit, the claim on this most beneficent bequest will not, it is hoped, be disregarded. The National Agricultural Society, in connection with the Institute, will most cheerfully aid Congress in carrying out their designs, for the great benefit of national industry.

It is a matter of sincere congratulation, that the Patent Office has so far recovered from its great loss in 1836, by the conflagration of the building, with all its contents. A continued correspondence with 11,000 patentees, and untiring efforts on the part of all concerned with this bureau, has accomplished much; indeed, to appearance, the models are better than previous to the fire. Although something remains yet to be done, enough has been accomplished to remove the past embarrassment, and afford applicants the means of examination as to the expediency of applying for a patent.

The loss to the library, sustained by the fire, is not yet fully repaired; and, since the law of 1836 makes it a duty to examine all applications for patents, with reference, also, to foreign inventions, it is absolutely necessary that the library should be extended.

It is true that the library of Congress possesses some books on scientific subjects, useful for reference in the labors of this bureau, but no permission is given to take out books from that library; and, if such liberty were granted, it would be bad economy to send an examiner to the capitol, to look up similar cases. If applications are to be examined, it will promote the despatch of public business, protect against spurious patents, and give public satisfaction, if the Patent Office library is well supplied with necessary books.

Already, hundreds of applicants are satisfied, by the comparatively imperfect examinations now made by referring to books on hand, not to take out a patent, and when, in the rejection of cases, reference is made to foreign patents, there is an impatient desire to see the description of the invention that is to cut off the hopes of so many years of toil and labor. I would therefore most earnestly recommend an appropriation of $1,200, from the surplus fund, to add to the Patent Office Library.

The annual agricultural statistics comprising the tabular estimate of the crops for the past year, with accompanying remarks and appendix, will be found subjoined, (marked A.)

The value of this document to the whole country, from year to year, it is believed, would justify a much larger appropriation from the Patent Office fund for this purpose. The diffusion of such information may save

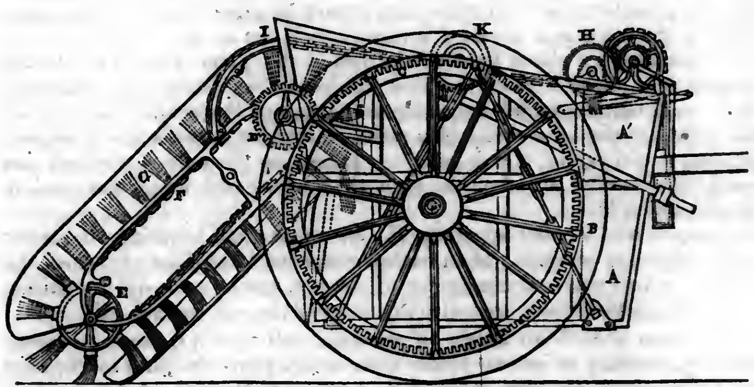
millions to the laborious tiller of the soil, besides adding directly to his means of export many millions more. An examination of this subject, and the expediency of fixing it on a more permanent and advantageous basis, by the constitution of an agricultural bureau, or at least an agricultural clerkship, at a moderate expense, to be drawn from the patent fund, is respectfully suggested. The additional benefit which must thus accrue to the population of our widely extended country would soon be seen.

A sufficient appropriation to allow a personal examination of the various parts of the country, by some one well qualified for such duty—similar to what has been attempted with so much success by some of the State legislatures—would, it is believed, realize a vast amount of practical good to the South and West, by furnishing the data on which they might direct their products to the best market, for domestic sale or foreign export.

Such, indeed, are the great benefits to result from personal observation and critical examination, not only of the crops, but agricultural implements—such the importance of explaining the new improvements, and collecting and distributing all the acclimated seeds, which are proved to be so signally productive or beneficial, that the Commissioner of Patents has doubted whether a modification of his duties, in connection with the Patent Office would not be more useful to the community. During the last year, he embraced the opportunity, while travelling to examine the crops in ten States; and though the examination was of course imperfect, it enabled him the better to digest the somewhat discordant materials from which the agricultural statistics here incorporated were compiled. If millions can be saved to the public, if the agriculturist can be encouraged in his all-important pursuits, by the expenditure of a small sum from the annual surplus of the patent fund, what better destination could be given to this amount? Would not the people heartily approve and earnestly second such an undertaking?

All which is respectfully submitted.

H. L. Ellsworth.



WHITWORTH'S PATENT SWEEPING MACHINE.

This machine, lately brought into operation in the town of Manchester, where it excited a considerable deal of public attention, has lately been introduced into the metropolis, and is now employed in cleaning Regent street. It is the invention of Mr. Whitworth, of the firm of Messrs. Whitworth & Co., of Manchester, engineers, by whom it has been patented. The principle of the invention consists in employing the rotary motion of locomotive

wheels, moved by horse or other power, to raise the loose soil from the surface of the ground and deposit it in a vehicle attached. The apparatus for this purpose is simple in in its construction; it consists of a series of brooms (3 ft. wide) suspended from a light frame of wrought iron, hung behind a cart, the body of which is placed near the ground, for greater facility in loading. The draught is easy for two horses, and throughout the process of filling, scarcely a larger amount of force is required than would be necessary to draw the full cart an equal distance.

The following description of the machine by a reference to the accompanying engraving, will explain its action. The cart is constructed with plate iron, and consists of two parts, A, A; the lower part A is suspended to the upper part, and when filled is lowered and replaced with an empty one. To the off-side wheel B, is attached, on the inside, a cog-wheel, C, which works into a pinion, D, on the end of a shaft the length of the back part of the cart, and fixed thereon are two pullies 1 ft. diameter and 2 ft. 4 in. apart: two other corresponding pullies, E, are fixed upon a lower shaft, which is suspended to the upper shaft by a wrought iron frame, and over these pullies pass two endless chains, F, to which the broom G, consisting of 29 rows, each 3 ft. 4 in. long, are attached. It will thus be seen, that when the large wheel of the cart is set in motion, it will, by means of the large spur wheel C, turn the pinion D, and with it the pullies and the endless chain and brooms that pass over them: and as these brooms come in contact with the road, they sweep the mud up the inclined plane into the bottom part of the cart A. For the purpose of raising the brooms from off the ground, there is an apparatus H, consisting of an endless screw working into a level wheel upon a shaft which passes across the top of the cart: upon this shaft are fixed two pullies, to which are attached two chains, which pass along the top of the cart and over the quadrants I, at the back, and there fixed to the iron frame of the apparatus,—so that when the endless screw is turned the chains are coiled round the pullies, and raise the apparatus to any height it may be requisite. For the purpose of removing or emptying the lower portion of the cart, it must be raised to a horizontal position; as this apparatus is raised it throws itself out of gear by means of a lever attached to a clutch fixed on the end of the pinion shaft D. To the apparatus H, there is another motion attached for regulating the pressure of the brooms on the ground, according to the state of the weather and the nature of the surface, consisting of a series of weights in the box in front, suspended to two chains, which pass over pullies on the axle of a wheel that works into another wheel on the same shaft as the first wheel described of the apparatus H.

There is also another apparatus K, for raising and lowering the lower part of the cart, consisting of an endless screw working into a cog-wheel, the shaft of which passes across the top of the cart, and on each end are pullies, round which the chains are coiled that suspend the cart on each side.

Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement: the cart, when full, is drawn to the side of the street, at some distance from a sewer grid, and the pipe plug being withdrawn, the water flows into the channel. A slight modification of the original form of the machine, by bevelling the cogs of the large spur wheel, C, throws the machinery more to the near side, and enables it to sweep close up to the curbstone of the foot pavement; and the hands before required to clean out the gutters are now dispensed with. An indicator, attached to the side of the sweeping apparatus, shows the extent of surface swept during the day, and

acts as a useful check on the driver. It also affords the opportunity of hiring horses to work the machine over a given quantity of surface, the rate of hire being per 1000 yards actually swept. This will be found convenient where parties working the machine do not keep their own horses, and will tend to facilitate the introduction of the new system under management of the local authorities.

When provision cannot conveniently be made in large towns for deposit in yards at proper intervals, the patent machine is constructed of two parts, as above described, viz., an upper A′, carrying a sweeping apparatus, and a lower A, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, A, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided,—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit. No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface—the round and square set stone,—the Macadamized road,—and the wood pavement; all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention and will, no doubt, tend to facilitate the general introduction of that useful invention. By the use of proper precautions in cleaning and oiling the machine before setting it to work, the friction of the working parts may be materially reduced,—a point of great importance, in reference both to the consumption of horse power, and the cost of repairs. The wear of the brooms, which at first was considerable, has been diminished more than one-half, by the action of the regulating weights before mentioned. A product of South America, called by the Portuguese "Piassava," forms an excellent material for the beard of the brooms, having great pliancy and strength combined, and also remarkable degree of durability.

Two machines are advantageously worked together, one a little in advance of the other. Not only is the operation of cleansing a particular street thus effected more rapidly, but the two drivers can occasionally assist each other, and one of them (at higher wages) may exercise a supervision over both machines.

The success of the operation is no less remarkable than its novelty. Proceeding at a moderate speed through the public streets, the cart leaves behind it a well swept track, which forms a striking contrast with the adjacent ground. Though of the full size of a common cart, it has repeatedly filled itself in the space of six minutes from the principal thoroughfares of Manchester. This fact, while it proves the efficiency of the new apparatus, proves also the necessity of a change in the present system of street cleaning.

SUSQUEHANNA AND DELAWARE RAILROAD.

We have had placed in our hands "A Report of the survey of a route from the proposed Susquehanna and Delaware railroad—from Pittstown on the Susquehanna through the centre of the Lackawannock coal formation in Luzerne and extending through parts of Pike and Northampton counties, Pennsylvania to the Delaware river at the Water Gap—with an estimate of its cost by Ephraim Beach, Esq., Civil Engineer," with remarks on the same by the Pennsylvania commissioners and Henry W. Drinker, Esq.

This admirable project has slept for a long period. It was surveyed in 1831. As a record of the formation of that part of Pennsylvania, and for reference, we give Major Beach's survey, with some extracts from the views taken by the commissioners, as to the advantages of the route, and the cost of transportation—which at that time was entirely heterodox, and looked upon as the dream of a visionary, to state that coal could be transported with profit at 2½ cents per ton per mile, when it is now ascertained that on the Philadelphia and Reading railroad they can do it for one-fourth of this sum—andover the Boston and Albany railroad, where their grades are as high as 85 feet, they transport at 1¾ cents per ton per mile.

We find there are two roads in New Jersey seeking extension to the Delaware river, and finally to connect with this projected railroad to the coal regions of Luzerne county, the one extending from Newark by Morristown, and the other from Elizabethtown to Somerville. There are no opposing obstacles to a railroad but a bridge over the Delaware, to reach both hard and soft coal. It is undoubtedly the shortest, the best and most level line from the city of New York to the Upper lakes, with the exception of the northern line by the pass at the Little Falls, Herkimer county, New York. From thence to near the foot of Niagara Falls, nearly a level can be obtained, on and near the ridge road—the supposed former shore of lake Ontario. On this line, as it can be formed with a descending grade from lake Erie at Buffalo to the Hudson, no route from the seaboard to the west can compete with it.

The route in question, with the exception of three planes, to be operated by water power, but which we learn have been dispensed with, at a less grade than those on the Massachusetts road—leads through the best part of New Jersey for agricultural and mineral paoducts. Independent of the coal and iron of Pennsylvania, there are extensive forests of the best white, yellow and spruce pine, with other valuable timber, the necessity of which to advance the growth of this city, will make lumber a great item of freight and profit to the road.

This is not all—now that a difficulty and legal questions have been raised between the Hudson and Delaware canal and New York and Erie railroad, which threaten to drive the latter into Sullivan county, and if persisted in may prostrate or delay for a long period the construction of this work, it is a matter of much importance to the citizens of New York to encourage the construction of the Susquehanna and Delaware railroad, as an enterprise that will take produce and merchandize in 181½ miles from Hoboken to the Great Bend, on a line much shorter than via. Piermont, to lake Erie.

	Miles.
From Jersey City via. Paterson to the Water Gap,	81
From the Water Gap to the coal region, in quantities,	53
From thence and the mouth of Leggett's creek to the Great Bend, as surveyed by J. Seymour,	47½
	181½

Twelve miles from the mouth of Leggett's creek will connect this line with Carbondale. The distance to Tioga Point or to Athens near the State line from Jersey City has been ascertained to be 232 miles.

The commissioners remark, pages 35, 36 and 37:

" By the Susquehanna and Delaware railroad and its connections, we conceive the wants and interests of the western New York will be better accommodated than by any other line which has yet been, or indeed that can ever be projected. A connection with the inexhaustible bodies of the coal of Luzerne county, it is scarcely necessary to say, will soon be as vital to the interests of Western New York as to her great and splendid commercial capital; while the same line that amply supplies these wants affords a most extended market for her agricultural produce, and at the same time connects the interests of that State (by the shortest possible line) with the parent city, whose position and commercial advantages are without a rival. The certain improvement of the Susquehanna to the State line, leaves the great question to depend alone on the success of our contemplated undertaking—an undertaking which has in its favor, as is conceived, unrivalled advantages.

" Entering at the western extremity a coal field, he extent and facilities of which are without a parallel—connected by the most direct lines pronounced practicable, and by improved channels already in operation, with the two greatest cities in America, we appear to have from these alone all the advantages, that in other cases have been found to produce ample remuneration, and to render valuable, investments in all undertakings where coal has been the basis of the trade.

" By a section of the Susquehanna river the south western counties of New York would be fully accommodated, while one of the lines which have recently been examined by Mr. Seymour to the Great Bend, would perhaps be more desirable to other parts of the State, to Owego, Ithaca, etc.

" Much has been said and written on railroads and canals, alternately aiming to prove the superiority of the one over the other; it seems probable that difference of situation and circumstances may prove both parties to be right. *But a union of the two in our climate, and where it can be avoided seems generally undesirable.* It is in effect the union of January and May. And when heavy articles, and particularly coal, constitutes the bulk of the transportation, it seems additionally undesirable.

" To a great extent a railroad must lay idle during the closing of a canal, forming part of its line, whether this be three or four months of the year—it is in either case unprofitable.

" It is a loss of so much interest on the capital expended, and is chargeable with a proportion of the loss of attendance and of the decay of the work. It is attended by many other disadvantages and probably does not afford that perfect communication which the advanced and advancing age seems to demand.

" Under this view it does not appear improbable that this line, at no distant day, will be united by continued railroad, with both Philadelphia and New York.

" The value of a continued railroad to a city during the winter season, has in some degree been developed by the recent operations of the Baltimore and Ohio work; longer experience will exhibit other valuable results. Railroads, while accomplishing the object of affording constant and steady winter supplies of fuel at uniform prices, which to the poor and to a part of the middling classes (whose means arise from day to day) is very desirable,

would at the same time afford supplies of many articles tending to increase the comfort and convenience of the citizen, and to add value to a city winter residence. The earliest and latest fruits of the earth, and the products of agriculture would more freely abound, and be afforded at more equal and moderate prices; fresh milk, fresh butter, so desirable would always be attainable; game from the interior, in fine and perfect order, would reach the market in its season, and the enjoyments of the table would be increased. To the country on the other hand, fish, oysters, and the produce of the sea, would be liberally distributed, and indeed it would appear that the condition of all in town and country would be much improved, nor would the effect be less beneficial to the citizens and to the public at large in other respects; trade and commerce would be invigorated; the stagnation that is now felt between the fall and spring sales of various merchandize would in a degree be removed, the demand would be more timely and more extensive, the purchases less hurried and more considerable. The railroad system would tend much to equalize the periods and amount of labor, to distribute human effort more equally throughout the seasons; at the present, in the late fall months, and as we approach towards the close of the year, there exists for a time very active, perhaps excessive employment, much to do, perhaps an insufficiency of laborers, every thing hurried, and often imperfectly accomplished.

"Then, as the severity of the winter closes around us, we experience a state as unprofitable to the citizen as it is injurious to the public morals; a state by which every one loses, by which no one gains; an evil is at once created —the formidable evil of having nothing to do. It seems to be an unerring law of our nature, that wherever this state of things exists, the moral scale of humanity is inevitably lowered: it lays above all things at the root of poverty and pauperism; to remedy which, volumes have been written, and millions have been expended. Railroads have at least this advantage, that they do not add to the number of winter idlers, which cannot with the same truth be asserted of canals."

With respect to cost of transportation we find at that early period the following observations—pages 28, 29 and 31:

OF THE COST OF TRANSPORTATION.

"On this question we have seen very few distinct and intelligent statements by American Engineers.

"Even on canals the cost of transportation presents nothing uniform, but is affected by the location, capacity, and construction of the several works. On some of the Pennsylvania canals, the calculations result in a cost of one half cent per ton per mile, while in other cases a much higher rate is assumed. Captain Beach does not go into any minute examination of the subject; he states generally the average of tolls and transportation on the canals 2½ cents per ton per mile, and these charges are noted as probably appliaable to the Susquehanna and Delaware railroad.

"As the cost of transportation will materially affect the price of coal at market, we are desirous, if possible, of arriving at more distinctness on this point.

"Some recent English publications reduce the cost of transportation on railroads to apparently so small an amount as to have excited doubts of the correctness of their estimates, an examination however of the separate items of charge, etc., on which these estimates are fonnded, in a great measure remove these doubts. In a note appended to "A Report descriptive of a route for a rail road from the Hudson, through Paterson to the Delaware river

at the Water Gap, and made by Col. Sullivan," we find the following: Mr. Booth in his account of the Liverpool and Manchester railroad computes all expenses, *including assisting engines at the inclined planes*, the water stations, and 7½ per cent interest on capital, supposing full employ, at 164-1000ths of a penny per ton per mile," a little more than three mills of our money.

"Mr. T. Earle, in his recently published treatise on railroads, estimates the performance of a single horse to be equal to the transport of 416 tons, one mile per day, making sufficient allowance for wagon hire, and for horse and attendant we find the transportation on a railroad by animal power to be about half a cent per ton per mile.

In the Report of the Pennsylvania Board of State Canal Commissioners on the Carbondale railway it is stated—

"The Company at a profit transport across the 16 miles of railway, at 35 cents per ton, exclusive of the toll." From other data furnished by the same report, it is evident that this charge might be reduced and leave sufficient to pay expenses. In another statement made at a different time by the engineer of that company, as cited by Col. Sullivan, the expenses of conveyance over the 16 miles of rail, requiring five stationary steam engines, is reported at 29½ cents. It is perfectly evident that these calculations have been predicated upon the actual amount transported, or expected to offer for transportation, at different periods during the year; and they are not based upon any estimate of the ascertained or probable capacity of the railroad. It is also equally manifest, that the cost of transportation over 16 miles, including *the whole ascent* in the direction of the trade, cost, fuel, and attendance at five stationary steam engines, with their ropes and apparatus within that distance, cannot furnish data for estimating the aggregate cost of transportation on a longer line comprising far more favorable sections—level planes, and all the descents.

"To throw some additional light on this subject, we avail ourselves of some data furnished by Mr. Seymour, in his report on a survey made by him in May, 1831, for the Lackawannack and Susquehanna railroad. In addition to his own authority we have the concurrent testimony of an engineer upon the only line of railroad improvement on our side of the water, which has as yet afforded experimental and practical illustration.

Mr. Seymour remarks—"It gives me pleasure to add, that upon showing the estimate to Mr. Archibald, the engineer for the Hudson and Delaware Canal Company, it met with an almost exact concurrence of opinion."

"We, therefore, conclude that, on favorable railroad lines, half a cent per ton per mile would probably meet the necessary expenditure for transportation, and that 1 cent per ton per mile will be an ample and sufficient estimate for the freight upon the Susquehanna and Delaware railroad when fairly in operation. The provisions of the act of incorporation give no limit to the charges for transportation, nor are we restricted to any per centage in this particular, all persons have liberty to use the railroad and transport upon it, they using the carriages, etc., as prescribed by the campany."

NEW YORK AND ERIE RAILROAD.

The bill in aid of this road having passed the last legislature, arrangements are about being made preparatory to recommencing the work. This bill, the details of which have been before published in this Journal, postpones the sale of the road to 1850, and so far releases the State lien on the

work as to allow of other loans taking precedence of the three millions of State loan.

Meanwhile the residents along the line for several miles beyond Goshen, prompted by a sound and judicious policy have completed the road in their section at their own cost.

IRON CANAL BOATS.

In your March No. 354, vol. X., page 173, I gave you a short article on this subject, and expressed the wish "that some of our enterprising forwarders will try the experiment of Iron Canal Boats." I am gratified to find a morning paper has the following, showing the complete success of this class of boats. In another article I proved, that their light draught of water, with increased cargo, would so add to the capacity of the Erie canal, even without taking into view the rapid decrease of the forest, as to render the enlargement of the Erie canal entirely unnecessary. This was more than two years ago. It is desirable to ascertain the cost of an Iron Canal Boat, compared with our best lake boats—the draught of water in each, with tons carried.

IRON BOATS AND ERICSSON PROPELLERS.

"New and wider spheres of enterprise open upon us every year; and none has been more marked in this respect than the present year. We found yesterday at one of the lower piers in South street, the iron boat Pilot, with Ericsson propellers, (belonging to Mr. Asa Worthington, of the Hope Mills in Front street,) loading for St. John, at the farther end of lake Champlain. She is the first boat which has done this. Freight she has offered much more than she can carry. At Coentie's Slip lay a large schooner with Ericsson propellers loading for Hartford, Ct. Iron boats now load at Philadelphia with coal, and proceed to Troy or to any other point where their cargoes are wanted, and then load again with salt or whatever else is offered in return. The effort to avoid transhipment is constantly succeeding more and more, and boats are being built which can pass through all varieties of navigation. To work cheaper and to work faster is the thing to which every one aims."

☞ Our canal commissioners should institute this enquiry. The expense would not be much and would lead to important results.

J. E. B.

STATISTICS OF LAKE STEAMERS.

The Buffalo Commercial Advertiser, on the completion of a quarter of a century since the first steamer was launched upon the western lakes, give a list of the steam vessels now on those waters. The total tonnage is 27,000, the cost $3,510,000 or $130 per ton.

The following remarks which we extract will prove interesting:

"In examining the progress of steam, as applied in propelling vessels on the lakes, we are struck with the very small number of disasters when compared with other sections of the country, especially on the western waters. In the whole period of 25 years there have been but four explosions which might be termed serious. It is true there are other disasters to re-

cord, whose calamitous details are too freshly impressed upon the public mind. The following tabular view presents both these classes:

Explosions—Lives lost.		*Burned—Lives lost.*	
Peacock, September 1830,	15	Washington, 2d June, '38,	50
Adelaide, June, 1830,	3	Erie, August, 1841,	250
Erie, August, 1840,	6	Vermillion, Nov. 1842,	5
Perry, twice in 1835,	6	Caroline, (wilful)	5
Total,	30	Total,	310

The number of boats yet remaining of the whole once in commission on lake Erie and the upper lakes is about sixty, with an aggregate of 17,000 tons. Of these some thirty-five only are used when the consolidation is in existence.

Of the whole number of boats in commission during the above period only ten were built and owned in Canada.

The first steamer known to be upon lake Michigan was the Henry Clay. In August, 1827, an excursion of pleasure was made in her to Green Bay, where Gov. Cass was holding a treaty with the Winnebagoes. After the treaty was concluded, Gov. C. and suite returned in the Clay. From that period to 1832 some of the boats went to Green Bay, but no further. On the breaking out of the Black Hawk war several of the larger boats were chartered by the government to convey troops to the disaffected territory, and Chicago for the first time was greeted with the sight of one of those strange visiters.

From the following notice we learn that two men, L. A. Sykes and Geo. S. Mills, have leased the Morris canal. From the enterprise and intelligence of these gentlemen we have no doubt that this work will be judiciously managed, and we hope with profit to the lessees.

"The Morris canal is again in navigable order, and business has been resumed through the enterprise of the new lessees, Messrs. George S. Mills and L. A. Sykes, with good promise of a brisk and profitable season. Full supplies of coal will, we understand, be sent down to market through this channel from the Lehigh mines by the Pennsylvania companies. We are also gratified to learn that the iron business at the various establishments on the route has been resumed and is to be extended during the season. The Stanhope Works are to be put in full operation, and, in addition to the old works at Boonton, a large nail factory is now in progress by a New England Company, which will be completed in the course of 60 days, and which is then expected to turn out some tons of nails daily. Preparations have also been made for the transmission of large supplies of ore from the rich iron mines of Morris county. There is very little, if any richer ore in the country than that furnished by Gov. Dickerson's mines at Sucasunna."—*Newark Daily Advertiser.*

THE PYRAMIDS OF GIZEH.

At the Royal Institute of British Architects, on the 6th ultimo, a letter was read from Mr. Perring, containing some remarks on the great Pyramid, accompanied by a model.

The model is on a scale of 30 feet in the inch, and represents the pyramid in its original condition,—that is, immediately after the sarcophagus was placed therein, and before the passages were filled with stone blocks closing the entrance. From an examination of the ancient Egyptian cubit, now remaining, I deduced the length to be 1·713 English feet divided into

four palms, each of seven digits. This measure, when applied to the pyramids, agrees as closely as to render its correctness certain, and I proceed to mention a few of the more obvious results in the edifice before us. The base covered a square of 448 cubits on each side, which, from a statement of Pliny, I take to have been equal to eight Egyptian jugera, or acres; and this supposition is somewhat confirmed by finding the second pyramid would then cover seven, and the third, one and three quarters of these supposed jugera, and so on with the other pyramids of Egypt. The height of the great pyramid appears to have been 280 cubits, being a proportion of height to side of base of 5 to 8; and I may here mention that several other pyramids have the same proportions. This gives the following ratio on a direct section: As half the base is to the perpendicular height, so is the apotheme, or slant height to the whole base; or for each side it may be thus stated as

Rad : Tang : : Sec : 2 Rad.

"Sir John Herschel having the angles only of the pyramids and their passage before him, gave his decided opinion that they were "not connected with any astronomical fact, and probably adopted for agricultural reasons; and the knowledge of the above proportions will I think lead to the same conclusion: for with the most solid and enduring shape possible, the builders obtained a mathematical symmetry which no other proportions could give. Although this pyramid was nearly 480 feet in perpendicular height of solid masonry, the pressure of the solid mass is so distributed, that the lower courses have only to sustain about 25,000 lb.; therefore it is evident that the main objects of the architect—viz., stability and eternal duration—were well effected. The inclination of the entrance passage of the great pyramid was regulated by a proportion of 2 to 1: that is, two feet horizontal to one foot perpendicular.

"The same mode of regulating the angles is observable in every instance; thus where inclined blocks were used to cover an apartment, a certain portion of the width of the room was taken for the rise or pitch; as in the queen's chamber, where the rise is a third of the width of the apartment, and also the angle of the air passages leading from the king's chamber to the exterior, have a rise of one perpendicular to two horizontal. From finding in every case that the angles were thus regulated, I have come to the conclusion that the Egyptians, at the time of the erection of these mighty monuments, possessed no knowledge of the division of the circle into degrees, but that their angles were regulated by the proportion of base to perpendicular height; in fact, the tangential measure of the angle, and not its abstract measurement. That they learned to divide the circle into degrees at a later period is highly probable, as they were celebrated for their astronomical knowledge.

"In every part of the pyramids evidences of premeditated and careful design are apparent; but my present purpose is to draw attention to the more striking points in the general pyramid only. The situation of the apartments in the pyramid appear to have been regulated as follows—

Height from base (external) to floor of passage of queen's chamber - - - - - - - -	40 cubits
From the above to floor of king's chamber, or principal apartment - - - - - - -	40 "
From the above to top of upper chamber - - - -	40 "
From the above to apex of pyramid - - -	160 "
Total - - - - -	280 cubits

Making 280 cubits in perpendicular height, as above stated. The floor

of the subterraneous apartment was also 60 cubits below the base of the pyramid."

THE THAMES TUNNEL.

This important undertaking was opened for foot passengers on the 25th of March last. Thus, after many years of anxiety and difficulty, perhaps without parallel in the history of great public works, the practicability of forming a thoroughfare for carriages and foot passengers under a deep navigable river, and without interruption to the navigation, is proved and executed. The obstacles, which have from time to time impeded, and all but stopped the progress of the tunnel, have been numerous. The work was commenced in 1825, but was stopped in 1828 by an irruption of the Thames. From that time to the spring of 1835 no progress was made. In this year, under the sanction of an Act of Parliament, the Treasury allowed the Exchequer Loan Commissioners to advance, out of the grant voted for public works, the money necessary to complete the tunnel; and it was again commenced and has been continued with but few inevitable interruptions and delays to the present time, when, as the directors have stated, it is securely completed, and is now thrown open to the public as a thoroughfare for foot passengers. The two roadways for carriages under the river are also perfectly completed. From its commencement to the present date there has been but 11 years within which the excavation could be carried on. And during this time, for nearly two years or ninety-nine weeks, the works were suspended from circumstances beyond the control of either the directors or the engineer. The work has been in fact executed in about 9 years of actual work, at a cost of about £446,000, including property and expenses of every kind, with the particulars of which the proprietors have been accurately and annually acquainted. The actual tunnel of 1200 feet was executed in eight years. The carriage-way descents are now alone wanting to complete the work. They are susceptible of being contracted for in the ordinary way.

☞ The editors of the Railroad Journal present their compliments to the *Officers, Engineers, and Superintendents* of Railroads, and request them to furnish for publication in its pages, any interesting or important fact which their experience may have established calculated to present the subject of railroads in its true light. Facts, *well established facts*, properly spread before this enlightened community are only necessary to ensure a gradual but *constant* extension and improvement of railroads in this country; and who can so readily furnish such facts as those constantly engaged in the construction and management of railroads? and what medium of publication so proper as the Railroad Journal? When important facts are furnished for *first* publication in the Journal, measures will be taken to give them extensive circulation through the newspaper press of the country, by sending *slips* to several hundred editors—and requesting its republication.

☞ Correspondents are requested to send in their communications early, as it is intended hereafter to issue the Journal and despatch it to subscribers, *before* the first of each month.

ERRATA—Page 161, tenth line from top, for "260 or thereabouts," read

240 *in number.* Same line, for "about eleven feet," read *ten* feet. Page 162, 14th line from top, for "of eleven feet," read of *ten* feet; 16th line from top, for "about eight feet," read *seven and a half feet.*

The March number of the Journal, which was passed over in order to come up with the train, will be issued and sent out with the number for July, and thus be again even with our cash subscribers, when —it cannot be doubted—others will make matters even with us for the past, and right for the future—in advance. Good fuel, and plenty of it, is essential to attain high velocities with the Locomotive—so also, is it important to the future success and improvement of this Journal, that arrearages should be liquidated, and none be allowed hereafter, to arise.

After a retirement of three years from all connection with its concerns, the undersigned again resumes his former station, in connection with his late associate, Mr. Geo. C. Schaeffer, as Editor and Publisher of the Railroad Journal, and Mechanics' Magazine. His retirement was from *necessity*, and a source of deep regret; his return is from *choice*, and, in the hope of contributing in some degree to make the Journal useful to the cause for which it has so long labored, highly gratifying to him.

The Journal, on its first appearance, January 1st, 1832, was cordially and generously greeted by the press throughout the country; and also by gentlemen connected with the *few* railroads then under construction; and, notwithstanding the oddity of its title, and the doubts of many as to the possibility of finding materials even to give a *tone* to its pages, much less to fill them, its course for several years was *onward;* but the *great fire* of December 1835, and the general depression of business for several years past, has borne heavily upon it. It has, however, been continued until the present period, from whence it is believed that we may look forward to more prosperous times: and to a gradual but *certain* extension and improvement of the railroad system; and it is now designed to make an effort to extend the circulation of the Railroad Journal, and increase its usefulness, by *reducing* the *price*, *stereotyping* its pages, and issuing it *punctually.*

To insure the success of the Journal under the new arrangement, a renewal of the courtesies of the *Press* and the friendly efforts of those interested in, or connected with, the works of internal improvement and the mechanic arts, throughout the country are respectfully solicited, and will be duly appreciated. D. K. MINOR.

New York, May, 1843.

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☞ This number contains one sheet of 32 pages. The postage is only one cent any distance within the State, or under one hundred miles, and one and a-half cents for over one hundred miles and out of the State.

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 7, Vol. I. Third Series. | JULY, 1843. | Whole No. 426. Vol. XVI.

DETERIORATION OF WROUGHT IRON AXLES.

Since the Paris railroad accident, much discussion has arisen as to the character of iron and mode of manufacture of axles. It is contended that those axles which have broken apparently from a flaw in the iron, have in reality become changed throughout their mass—that the fibrous structure of wrought iron is changed in course of time into a cristalline and brittle grain—and that these changes occur in the best made axles, and in the best quality of iron, and that they are produced by long continued use.

How far these assertions are correct it is difficult to say, the interest of manufacturers is to shorten as much as possible the period during which an axle can be worked with safety; on the other hand it is probable that the consumers are willing to believe that the longest possible period that can be named is more near the truth. Some of the statements made in foreign Journals are evidently influenced in the manner first named. Still we should be cautious about denying that any change of this kind does take place, as it is well known that a similar gradual passage to the cristalline structure is known to take place in other metals and in alloys. It is not unlikely that the vibration throughout the iron, caused by the constant jar of passing over the rails, may produce this change with rapidity.

A writer in the Civil Engineer and Architects Journal gave in confirmation of this theory the statements of a French manufacturer of great experience. This gentleman has arrived at the conclusion that an axle can only safely run about 75,000 miles; after that time it is his constant practice to take it out, place it between two new bars of iron, and weld the whole together into a new axle. He also states that when paved roads are passed over, the distance run is not so great to produce the same effects, and that according to his experience the wear of the collar is a direct measure of the length of time during which the axles may be considered safe.

From the statements which may at least be considered as not far from the truth, we may infer that the character of the road will greatly influence the duration of the axles—that a firm, hard and unyielding structure will cause

their more rapid deterioration, while a more elastic road, if well laid and constantly kept in repair, may allow of their use for an indefinite period. It is to this cause that we attribute the want of coincidence of the experience of this country and that of Europe. That a time will arrive, beyond which it will not be safe to use an axle, no matter how favorable the structure of the road, there can be no doubt—the only question is, what this time may be. The experience of many years will probably be required to determine the question.

The want of precise information upon this point, need not, however, deter us from attempting to prevent or retard such changes in iron. The manner in which this may be accomplished can only be ascertained by experiment, yet useful suggestions may be made derived from correct reasoning upon well ascertained facts, or from the small amount of experience now in our possession. The most simple suggestion which has been made is this. The same alteration takes place under the influence of heat improperly applied, it is therefore a question whether the electricity or magnetism developed by friction may not be in some measure the agent in producing a cristalline structure. It is proposed, therefore, to reverse the motion of the axle so as to prevent this action, or rather that the effects produced by motion in one direction may be neutralized by motion in the other direction.

Another proposal which we have to make, is that the axle should be loaded with pieces of iron or lead fastened upon it at one or more points, and that the position of these should be from time to time changed; by this means the direction and force of the vibrations will never be the same for any great length of time, and the cristalline texture may thus be prevented from assuming that regularity of grain which renders the mass brittle.

Since writing the above, we have obtained a copy of the paper of Mr. Charles Hood upon this subject, which seems so much to the purpose that we insert the whole of it.

CHANGES INDUCED IN THE STRUCTURE OF IRON SUBSEQUENT TO MANUFACTURE.—BY CHARLES HOOD, ESQ., F.R.A.S.

The important purposes to which iron is applied have always rendered it a subject of peculiar interest; and at no period has its importance been so general and extensive as at the present time, when its application is almost daily extending, and there is scarcely anything connected with the arts, to which, either directly or indirectly, it does not in some degree contribute. My object in the present paper is to point out some peculiarities in the habitudes of iron which appear almost wholly to have escaped the attention of scientific men; and which although in some degree known to practical mechanics, have been generally considered by them as isolated facts, and not regarded as the results of a general and important law. The circumstances, however, well deserve the serious attention of scientific men, on account of the very important consequences to which they lead. The two great distinctions which exist in malleable wrought iron, are known by the names of "red-short" and "cold-short" qualities. The former of these comprises the tough fibrous iron, which generally possesses considerable strength when cold; the latter shows a bright crystallized fracture, and is very brit-

tle when cold, but works ductile while hot. These distinctions are perfectly well known to all those who are conversant with the qualities of iron; but it is not generally known that there are several ways by which the tough red-short iron becomes rapidly converted into the crystallized, and by this change its strength is diminished to a very great extent.

The importance which attaches to this subject at the present time, will not I think, be denied. The recent accident on the Paris and Versailles railway, by which such a lamentable sacrifice of human life has occurred, arose from the breaking of the axle of a locomotive engine, and which axle presented at the fractured parts the appearance of the large crystals, which always indicate cold-short and brittle iron. I believe there is no doubt however, that this axle, although presenting such decided evidence of being at the time of this accident of the brittle cold-short quality, was at no distant period tough and fibrous in the highest degree. I propose, therefore, to show how these extraordinary and most important changes occur, and shall point out some at least of the modes by which we can demonstrate the truth of this assertion by actual experiment.

The principal causes which produce this change are percussion, heat, and magnetism; and it is doubtful whether either of these means *per se* will produce this effect; and there appear strong reasons for supposing that, generally, they are all in some degree concerned in the production of the observed results.

The most common exemplification of the effect of heat in crystallizing fibrous iron, is by breaking a wrought iron furnace bar, which, whatever quality it was in the first instance, will, in a short time, invariably be converted into crystallized iron; and by heating, and rapidly cooling, by quenching with water a few times, any piece of wrought iron, the same effect may be far more speedily produced.

In these cases we have at least two of the above causes in operation—heat and magnetism. In every instance of heating iron to a very high temperature, it undergoes a change in its electric or magnetic condition; for, at very high temperatures, iron entirely loses its magnetic powers, which return as it gradually cools to a lower temperature. In the case of quenching the heated iron with water, we have a still more decisive assistance from the electric and magnetic forces; for Sir Humphry Davy long since pointed out (Chem. Phil., p. 138) that all cases of vaporization produced negative electricity in the bodies in contact with the vapor—a fact which has lately excited a good deal of attention, in consequence of the discovery of large quantities of negative electricity in effluent steam.

These results, however, are practically of but little consequence; but the effects of percussion are at once various, extensive, and of high importance. We shall trace these effects under several different circumstances.

In the manufacture of some descriptions of hammered iron, the bar is first rolled into shape, and then one-half the length of the bar is heated in a furnace, and immediately taken to the tilt-hammer and hammered; and the other end of the bar is heated and hammered in the same manner. In order to avoid any unevenness in the bar, or any difference in its color, where the two distinct operations have terminated, the workman frequently gives the bar a few blows with the hammer on that part which he first operated upon. That part of the bar has, however, by this time become comparatively cold; and if this cooling process has proceeded too far when it receives this additional hammering, that part of the bar *immediately* becomes crystallized, and so extremely brittle that it will break to pieces by merely throwing it on the ground, through all the rest of the bar will exhibit the best and

toughest quality imaginable. This change, therefore, has been produced by percussion (as the primary agent,) when the bar is at a lower temperature than a welding heat.

We hear see the effects of percussion in a very instructive form. And it must be observed that it is not the excess of hammering which produces the effect, but the absence of a sufficient degree of heat at the time the hammering takes place; and the evil may probably be all produced by four or five blows of the hammer, if the bar happens to be of a small size. In this case we witness the combined effects of percussion, heat, and magnetism. When the bar is hammered at the proper temperature, no such crystallization takes place, because the bar is insensible to magnetism. But as soon as the bar becomes of that lower degree of temperature at which it can be affected by magnetism, the effect of the blows it receives is to produce magnetic induction; and that magnetic induction and consequent polarity of its particles, when assisted by further vibrations from additional percussion, produces a crystallized texture. For it is perfectly well known that in soft iron, magnetism can be almost instantaneously produced by percussion; and it is probable that the higher the temperature of the bar at the time it receives the magnetism, the more likely will it be to allow of that re-arrangement of its molecules which would constitute the crystallization of the iron.

It is not difficult to produce the same effects by repeated blows from a hand-hammer on small bars of iron; but it appears to depend upon something peculiar in the blow, which, to produce the effect, must occasion a complete vibration among the particles in the neighborhood of the part which is struck. And it is remarkable that the effects of the blows in all cases seem to be confined within certain limited distances of the spot which receives the strokes. Mr. Charles Manby has mentioned to me a circumstance which fully bears out this statement. In the machine used for blowing air at the Beaufort iron works, the piston rod of the blowing cylinder, for a considerable time, had a very disagreeable jar in its motion, the cause of which could not be discovered. At last the piston rod broke off quite short, and close to the piston; and it was then discovered that the key had not properly fastened the piston and rod together. The rod, at the fracture, presented a very crystallized texture; and as it was known to have been made from the very best iron, it excited considerable surprise. The rod was then cut at a short distance from the fracture, and it was found to be tough and fibrous in a very high degree—showing what I have already pointed out, that the effects of percussion generally extend only a very short distance. In fact, we might naturally expect, that as the effect of vibration diminishes in proportion to the distance from the stroke which produces it, so the crystallization, if produced by this means, would also diminish in the same proportion. The effect of magnetism alone may also be estimated from this circumstance. The rod would of course be magnetic throughout its whole length, this being a necessary consequence of its position, independent of other circumstances; but the necessary force of vibration among its particles only extended for a short distance, and to that extent only did the crystallization proceed. The effect of magnetism in assisting the crystallization, I think it unnecessary to dwell upon, as the extensive use of galvanic currents in modern times has fully proved their power in crystallizing some of the most refractory substances; but by themselves they are unable to produce these effects on iron, or at least the operation must be extremely slow.

Another circumstance which occurred under Mr. Manby's observation, confirms generally the preceding opinions. A small bar of good tough iron

was suspended and struck continuously with small hand hammers, to keep up a constant vibration. The bar, after the experiment had been continued for some considerable time, became so extremely brittle, that it entirely fell to pieces under the light blows of the hand hammers, presenting throughout its structure a highly crystallized appearance.

The fracture of the axles of road vehicles of all kinds is another instance of the same hind. I have at different times examined many broken axles of common road vehicles, and I never met with one which did not present a crystallized fracture; while it is almost certain that this could not have been the original character of the iron, as they have frequently been used for years with much heavier loads, and at last have broken, without any apparent cause, with lighter burdens and less strain than they have formerly borne. The effects, however, on the axles of road vehicles are generally extremely slow, arising, I apprehend, from the fact that, although they receive a great amount of vibration, they possess a very small amount of magnetism, and are not subject to a high temperature. The degree of magnetism they receive must be extremely small, from their position and constant change with regard to the magnetic meridian, the absence of rotation, and their insulation by the wood spokes of the wheels. Whether the effects are equally slow with iron wheels used on common roads, may perhaps admit of some question. With railway axles, however, the case is very different. In every instance of a fractured railway axle, the iron has presented the same crystallized appearance; but this effect, I think, we shall find is likely to be produced far more rapidly than we might at first expect, as these axles are subject to other influences, which, if the theory here stated be correct, must greatly diminish the time required to produce the change in some other cases. Unlike other axles, those used on railways rotate with the wheels, and consequently must become, during rotation, highly magnetic. Messrs. Barlow and Christie were the first to demonstrate the magnetism, by rotation, produced in iron; which was afterwards extended by Messrs. Herschel and Babbage to other metals generally, in verifying some experiments by M. Arago. It cannot, I think, be doubted that all railway axles become from this cause, highly magnetic during the time they are in motion, though they may not retain the magnetism permanently. But in the axles of locomotive engines, we have yet another cause which may tend to increase the effect. The vaporization of water, and the effluence of steam, have already been stated to produce large quantities of negative electricity in the bodies in contact with the vapor; and Dr. Ure has shown (Jour. of Science, vol. v. p. 106) that negative electricity, in all ordinary cases of crystallization, instantly determines the crystalline arrangement. This, of course, must affect a body of iron in a different degree to that of ordinary cases of crystallization; but still we see that the effects of these various causes all tend in one direction, producing a more rapid change in the internal structure of the iron of the axle of a locomotive engine than occurs in almost any other case.

Dr. Wollaston first pointed out that the forms in which native iron is disposed to break are those of the regular octahedron and tetrahedron, or rhomboid, consisting of these forms combined. The tough and fibrous character of wrought iron is entirely produced by art; and we see in these changes that have been described an effort at returning to the natural and primal form—the crystalline structure, in fact, being the natural state of a large number of the metals; and Sir Humphry Davy has shown that all those which are fusible by ordinary means assume the form of regular crystals by slow cooling.

The general conclusion to which these remards lead us, appears, I think,

to leave no doubt that there is a constant tendency in wrought iron, under certain circumstances, to return to the crystallized state; but that this crystallization is not necessarily dependent upon time for its development, but is determined solely by other circumstances, of which the principal is undoubtedly vibration. Heat, within certain limits, though greatly assisting the rapidity of the change, is certainly not essential to it; but magnetism, induced either by percussion or otherwise, is an essential accompaniment of the phenomena attending the change.

At a recent sitting of the Academy of Sciences at Paris, M. Bosquillon made some remarks relative to the cause of the breaking of the axle on the Versailles railroad; and he appears to consider that this crystallization was the joint effect of time and vibration, or rather, that this change only occurs after a certain period of time. From what has here been said, it will be apparent that a fixed duration of time is not an essential element in the operation: that the change, under certain circumstances, may take place instantaneously; and that an axle may become crystallized in an extremely short period of time, provided that vibrations of sufficient force and magnitude be communicated to it. This circumstance would point out the necessity for preventing as much as possible all jar and percussion on railway axles. No doubt, one of the great faults of both engines and carriages of every description, but particularly the latter, is their possessing far too much rigidity; thus increasing the force of every blow produced by the numerous causes incidental to railway transit, by causing the whole weight of the entire body in motion to act by its momentum, in consequence of the perfect rigidity of the several parts, and the manner of their connection with each other, instead of such a degree of elasticity as would render the different parts nearly independent of one another in the case of sudden jerks or blows; and which rigidity must produce very great mischief both to the road and to the machinery moving upon it. The looseness of the axles in their brasses must also be another cause which would greatly increase this evil.

Although I have more particularly alluded to the change in the internal structure of iron with reference to the effects on railway axles, it need scarcely be observed that the same remarks would apply to a vast number of other cases, where iron, from being more or less exposed to similar causes of action, must be similarly acted upon. The case of railway axles appears to be of peculiar and pressing importance, well deserving the most serious consideration of scientific men, and particularly deserving the attention of those connected with railways, or otherwise engaged in the manufacture of railway machinery, who have the means of testing the accuracy of the theory here proposed; for if the views I have stated be found to harmonize with the deductions of science, and to coincide with the results of experience, they may have a very important effect upon public safety. It may be observed on the other hand, however, that at the present time all railway axles are made infinitely stronger than would be necessary for resisting any force they would have to sustain in producing fracture, provided the iron were of the best quality; and to this circumstance may perhaps be attributed the comparative freedom from serious accidents by broken axles. The necessity for resisting flexure and the effects of torsion, are reasons why railway axles never can be made of such dimensions only as would resist simple fracture; but it would be very desirable to possess some accurate experiments on the strength of wrought iron in different stages of its crystallization, as there can be no doubt that very great differences exist in this respect; and it is probable that in most cases, when the crystallization has once commenced, the continuance of the same causes which first produced it goes on continu-

ally increasing it, and thereby further reduces the cohesive strength of the iron.

PROFESSIONAL EMPLOYMENT.

There are several very common misapprehensions in regard to Civil Engineers which we conceive to be the cause of much loss, to the profession of employment, and to the public of valuable services, obtainable at not greater cost than the less valuable substitute commonly resorted to. It is of the highest consequence to the profession that these errors should be corrected fully and promptly.

The public estimate of the proper sphere of engineering duty, is limited to the construction of railroads, canals, and sometimes, bridges. The construction, as well as the laying out of common roads, the building of piers, wharves, sea-walls, etc., of the large majority of bridges, of large edifices whose strength depends entirely on the disposition of material—all these, and many other labors belonging properly and exclusively to the profession of civil engineering, are almost universally assigned to those who should not be permitted to venture beyond the mechanical duties of construction under some competent superintendance.

In bridges, and other large structures, it is customary to employ no other engineer than the builder, constructor or contractor himself. The impropriety of this proceeding would, we should think, be so manifest that no one consulting his own interest would attempt it. That the same person should, both plan the work and construct it, and thus become a judge of his own performance is a most unusual mode of doing business.

The popular mistakes upon this point, have arisen from the constant demand for engineers upon our railroads and canals having until recently allowed no opportunity for their employment upon other works—even if it had been desired. We should not think there could be any doubt as to the capacity of a properly instructed engineer. The nature of his profession is such that he is compelled to pay attention to many and diverse modes of construction, and to the general applications of physical science. In fact the education of a civil engineer embraces the full consideration of all the arts of construction, and he is therefore a better projector of building than either a carpenter or a mason.

The unfrequent employment of our own civil engineers in other than works of public improvement, has in a measure arisen from the vast numbers of needy adventurers from abroad who have hitherto forced themselves into all situations of this kind. Men unknown at home, have pretended to instruct the whole profession in this country—and in several instances it has been shown that these very men have never been previously employed in any other than subordinate situations, such as do not even require any acquaintance with the profession of those by whom they are employed.

The results of this practice have been doubly disadvantageous, by exclu-

ding our own engineers from employment, and also by throwing discredit upon the very name of civil engineer.

At the present time when but few railroads or canals are in process of construction, a large number of well informed and capable civil engineers are without anything to do. The resort to such men for advice, would not only be employment to them, but profit to those consulting. This subject is deserving of consideration by all parties. If much skill and intelligence now remains unemployed and may by any arrangement be brought into use, this certainly would be a public benefit, as well as an individual accomodation.

PRACTICAL REMARKS ON BLAST FURNACES.—BY GEO. THOMSON, ESQ., MINING ENGINEER.

[Read before the Glasgow Philosophical Society, 4th January, 1843.]

There is a manifest absence of anything like correct principle in iron smelting; and although the reduction of ore by cementation may be an easily explained operation, yet, the peculiar combinations brought to bear in the blast furnace, seem to present a problem which chemical science is as yet unable to explain.

In the attempted solutions of the problem, a too limited number of facts have been generally considered, and generalizations attempted, from facts bearing partially on unvaried conditions. Following the system of induction, if a true principle is only to be attained through the medium of facts in every variety and under every possible condition, the object may be assisted, in some measure, by my laying before the society a few facts which have come under my own observation, and may be peculiar. The results given are divided into three principal conditions; viz., 1st, as respects the direct influence, *cæteris paribus*, of different material. 2d, influence of shape and size. 3d, influence of blast, as to diffusion, pressure, or quantity.

1st, *Influence of material.*—Although *all* the materials used in smelting have a certain influence; it is the coal which gives the most extraordinary results as respects "yield." A few results of various coals are therefore collected into the following table from my own immediate observation. The word "yield," is used to denote the comparative quantity of coals used in the furnace, to produce, or to smelt a ton of iron. In the table, the weekly quantity of iron given, as produced by hot blast, is small in comparison with what is now made at most furnaces; yet these are the more correct *comparative* results, having been attained with like conditions of size shape, number of tweres, etc. Since that time, the shape and size of furnaces have been materially altered, as well as other conditions, and the make greatly increased.

Referring to the table, the first three coals are found in the same coal-field and at no very great depth from each other. The cold blast results of these came directly under my own observation, and are taken from several years' work; the hot blast results are from a neighboring work, and subject to similar conditions in almost every respect. Here, then, in the same coal-field are three different coals, which, when under similar conditions with cold blast, give very different results; so much so, as to have taken nearly twice as much of one kind of coal to make a ton of iron as of another (yard coal 6½ tons, clod coal 3 tons;) but when the hot blast is applied, we find they are very nearly assimilated, so that, upon the coal which works *best* with cold blast, that application has scarcely any effect, while on the inferior coal it has a most surprising one.

TABLE No. 1.

PLACES.	COALS.			RESULTS.				
				COLD BLAST.		HOT BLAST.		
	No.	Local name.	Loss in Coking.	Coal to a ton of iron in furnace.	Weekly produce from 1 furnace.	"Raw," or Coked.	Coal to a ton of iron in furnace.	Weekly produce from 1 furnace.
SHROPSHIRE, (Lightmoor Works,)	1	Clod Coal,	45 per cent.	3 Tons.	70 Tons.	Coked.	$2\frac{1}{2}$ Tons.	80 Tons.
	2	Yard Coal,	50 —	5 to $5\frac{1}{2}$	40	Coked.	$2\frac{1}{2}$ to 3	80 —
	3	Little Flint Coal,	50 —	4	50 to 60	Coked.	$2\frac{1}{2}$ to 3	80 —
		Do.	Uncoked.	$2\frac{1}{2}$ to 3	50 to 60			
SOUTH STAFFORDSHIRE, (Wedensbury Work,) .	4	Thick Coal,	45 per cent.	3	60	Raw.	$2\frac{1}{2}$	80 —
	5	Tipton Coal,	45 —	$5\frac{1}{2}$	35	Raw.	$2\frac{1}{2}$	60 —
NORTH STAFFORDSHIRE, (Fenton Park,) . .	6	Ash Coal,	50 —	$5\frac{1}{2}$	35	$\frac{1}{2}$ Coke, $\frac{1}{2}$ Raw.	$3\frac{1}{2}$	45 —
	7	Rider Coal,	55 —	$7\frac{1}{2}$	25	Coked.	$4\frac{1}{4}$	40 —

DESCRIPTION OF COALS.

No. 1 is soft, stratified, and dull; horizontal sections filled with carbonaceous matter; burns with a white ash; produces a soft coke, which retains carbonaceous matter in divisions.

No. 2. Rather hard, cubical and bright; calcareous matter in transverse divisions; burns to a brown ash; produces a hard coke, and is considered very sulphury.

No. 3. Hard, cubical, shining; burns to a white ash; produces a very hard coke.

No. 4, is of various stratifications, differing in character; is generally known.

No. 5. Schistous, very friable, with carbonaceous matter between horizontal layers.

No. 6. Bright, conchoidal, free burning, and renders a white ash; is preferred for burning the china and "pottery ware" of the district.

No. 7. Bright, conchoidal, burns very hot, leaves a brown ash. A stratum of pyrites lies directly below it in the coal field, of about six inches in thickness.

The two next coals in the table from the Wolverhampton coal field, show a similar result. The sixth and seventh, or the last two coals of table No. 1, belong to North Staffordshire—the district of the "Potteries." There my results are also given from a direct personal observation of several years; and I do not think I err in saying, that the materials of this district, taking

coal and ironstone together, are the worst in the kingdom for iron smelting. The coals given are compared under precisely similar conditions both with cold and hot blast, and although obtained from the working of a very small furnace, (only 32 feet high,) the *comparative* results will not be affected thereby. They lie very close to each other, being merely separated by a stratum of shale a few feet in thickness, often less, and, consequently, show how great a difference occurs, not only in different districts, but within a few yards, vertically, of the same field.

With modifications of the shape, and increase of size, (to which we shall attend more particularly under that head,) we were ultimately able to work No. 6, ash coal, in the furnace, without coking, and at a consumption of only 2½ tons to the ton of iron, with a make of upwards of 70 tons a week; but No. 7, rider coal, although these conditions altered the make considerably, and the yield slightly, we were never able to work *without* coking; again and again we tried to do so by commencing with a small quantity, and gradually increasing it, but in vain; every increase of this coal to the burden, without coking, was followed by a decrease of yield, make, and quality.

As regards ironstone, the effects of different qualities are not so striking as those of coal, with respect to *yield*, but they have a great influence on the *quality* of the iron produced. For instance, that which is known as the Shropshire pennystone—a peculiar kind of argillaceous ironstone found in small nodules imbedded in a stratum of indurated clay—and containing about 30 to 35 per cent. of iron, is supposed to give the peculiar strength and toughness to the Shropshire pig iron. When another ironstone, (siliceous) locally termed "crawstone," which is found partially stratified in a bed of sandstone rock, is mixed with the pennystone, even in proportion of 1 to 10, the effect is very observable in making the iron much more fluid, altho' it retains its stoutness. Again the effect of the "red ore" of Cumberland, or peroxide of iron, mixed with argillaceous, or other ironstone, is well known; it adds in every case very materially to the strength of the iron, and the effect is especially so with the hot blast. Forge cinder, which is a protoxide of iron, mixed with silecious, or other foreign matter, has a directly contrary effect both with cold and hot blast,—so much so, indeed, that I have seen hot blast iron which had been made with a large proportion of "cinder," so weak as to break into several pieces when dropped on the ground from the height of a couple of feet. I may here remark, that it is not surprising that we should hear so many conflicting opinions on the *strength* of hot blast pigs, by those who only quote results without considering the conditions which affect them.

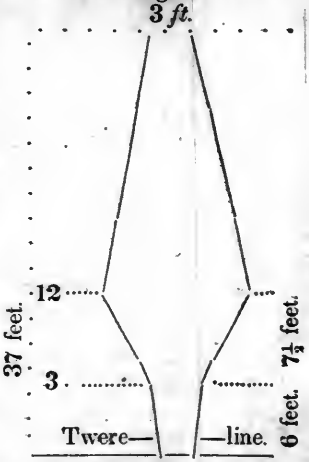
These results on the quality of iron by the use of different kinds of ironstone are very general, but such effects are well know, and are constant; and when we consider that there is only one kind of iron, in fact, surely it is worthy the attention of the scientific to inquire whence arise such differences, and how they should be produced by a simple mixture of "red ore," or of "forge cinder."

2d, *Influence of shape and size.*—We now come to a few results connected with the shape of furnaces; and on this point there seems to be at different times a ruling fashion. At the time of making the experiment to which I shall first refer, which was before the hot blast had been brought into notice, the prevailing fashion in England was to make the furnaces as narrow as possible, both at the "neck," or filling place, and at the "hearth." The furnace on which the experiment was made was at Lightmoor, in Shrop-

shire, the shape and size of which is represented in fig. No. 1. It worked worse than any of the others with the same coal, which was a mixture of those already referred to in table I; and the only difference of its shape, compared with the others, is in being about 6 to 9 inches wider at the boshes, and three feet less in height.

This furnace consumed about 5 tons of coals in producing a ton of iron, and made only about 40 tons per week. The alteration made upon it was very simple to appearance, consisting only of widening the top from 3 feet, to 5 feet diameter, and carrying that width perpendicularly up 6 feet higher; also placing two filling holes, one on each side, over tweers, instead of one in the middle, merely, as it were, placing a cylinder of 5½ feet diameter and 6 feet high upon the top.

Fig. 1.



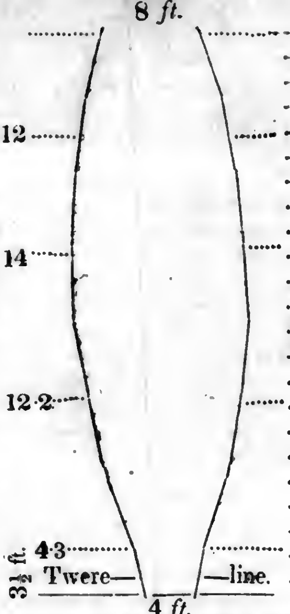
Simple as the alteration appears, however, it was followed by very extraordinary results; the moment the charge arrived at the bottom, the iron from hard forge, became fine No. 1. The burden was accordingly increased from time to time, until this furnace with the same material and same blast, made 60 tons per week of good forge pigs, with a consumption of only 3½ tons of coal to a ton of iron. The result is not attributable to the widening and double filling holes alone; for the effect was repeatedly tried by filling holes at the original height directly under the upper ones, and in every case we had to take burden off to make an equal quality, thereby reducing both the quantity and the yield.

Mr. Gibbons, of Corbyns Hall furnaces, near Dudley, has arrived at very striking results with cold blast, by alteration of shape and increase of size. He states in his publication on the subject, that he was led to the idea by observing the well known fact, that furnaces, especially cold blast ones, scarcely ever come into full work until six months after they have been blown in; and also, that every year, so long as the "boshing" of the furnace is not wholly gone, they improve their work both in yield and in quantity; further, in observing that furnaces, when blown out, although they had not been working for more than six or eight months, were materially altered from their original shape. By studying the natural shape, as it might be termed, he has arrived at an improved form.

This improved furnace (fig. 2,) has more than double the capacity of his original one, the dimensions of which were 8 feet wide on the hearth, 3½ feet at the boshes, 12 feet at the belly, and 4 feet at the top. The height from the hearth to the boshes 6 feet, from the boshes to the belly 8 feet, total height, 45 feet; and the larger content is in the upper half—the top is 8 feet diameter, and there are four filling holes. The greatest produce of his original furnace he states to have been 74 tons per week, while that of the improved one has reached 115 tons in one week. This is by cold blast, with a density of only 1 lb. 13 oz. per inch at the twere.

Mr. Gibbons' opinion, like that of many others, is, that with the hot blast the shape or the size has very little effect; but that this is not the case is now well known.

Fig. 2.



3*d*, *Influence of Blast.*—In cold blast working, some practical men hold that the density of the blast should not exceed 2 lbs. to the inch, while others work it as high as 3 lbs. to the inch, or even more. In re-smelting also in the cupola, many prefer the fanners, which give a much *softer* blast than the old method of the cylinder; while others, after having tried the fanners, have returned to the original and stronger blast of the cylinder. We cannot suppose that this is altogether fancy or prejudice; I have no doubt that the differences of the material subjected to the blast is the cause, in a great measure, of such opposite results.

At Lightmoor, the various requirements of blast to make the best yield, with the different coals, were striking; coal No. 1, (of table I.,) which is the best, required a considerably less dense blast than the inferior, No. 2, (coal yard.) Indeed, blast, either in volume or pressure, seemed to be of little consequence to the working of the clod coal, from 1¾ lbs. to 2¾ lbs. to the inch, the yield was not affected, the only difference being a slight increase of quantity. Nor did diffusing the blast by a number of tweres seem to make a material difference. It is a fact that with this coal, and a furnace of ordinary dimensions, 60 tons of iron have been made in a week by one blast pipe only, the muzzle only 3 inches diameter, or 9 circular inches of blast.

On the other hand, the inferior, or, as they are called there, the "sulphury" coals, required a highly compressed blast to bring them to their best yield—one under 2½ lbs. to the inch gave very inferior results; compare this with Mr. Gibbons' result, his materials seem well adapted for cold blast working, and we find density of blast not a great object to them. 1 lb. 13 oz. only was his density at tweres, and this continued the same although he doubled the capacity of his furnace.

[To be continued.]

RAILROAD ITEMS.

Utica and Schenectady railroad.—The old board of Directors are re-elected. Erastus Corning, President.

Meeting of stockholders of Norwich and Worcester railroad.—The annual meeting of the stockholders of this road took place in this city yesterday. The meeting was large and the action upon the various subjects which came up harmonious. The treasurer's report shows a very decided and important improvement in the affairs of the company since the last annual meeting. The most important question acted upon was that of the extension of the road down the river to a point near the sound. By an almost perfectly unanimous vote, it was resolved thus to extend the road, and we presume the work will be commenced forthwith. The precise point to which the extension shall be made, is not yet fixed upon, the matter having been referred to a committee to examine and report hereafter.

Daniel Tyler was re-elected president.—*Norwich Courier.*

The following gentlemen were on Monday unanimously elected directors of the New Jersey railroad and transportation company for the ensuing year:—J. S. Darcy, Adam Lee, Stephen Whitney, John P. Jackson, John Acken, J. Phillips Phœnix, D. S. Grégory, Wm. S. Johnson, Abraham G. Thompson.—*N. Y. American.*

The United States steamer Union.—The Courier and Enquirer of June 3d says: "This new national steamer, on the plan of Lieut. Hunter, arrived in our harbor on Thursday, and, we are proud to say, has completely demonstrated the feasibility and superiority of this invention over all others. We were among those who doubted its success; and yet we feel assured that there is no individual in the country who more sincerely rejoices than we do in this practical triumph of Mr. Hunter in securing to his country and to the world a steam vessel which, at all times and under all circumstances, may be exposed to an enemy's fire without danger to her wheels. We are pleased to hear that Mr. Hunter is quite sanguine of very greatly increasing the speed of the next vessel to be built upon the same plan."

Charles L. Schlatter, Esq., Chief Engineer of the public works of Pennsylvania, has resigned, having received an appointment from the war department, which will station him at Chicago.

HARTFORD AND SPRINGFIELD RAILROAD.

This long talked of railroad, is, we have evidence to believe, soon to be completed. It *ought* to have been done at an earlier date. Its completion will make the *fourth* railroad from the waters of Long Island Sound, connecting with that great *main artery*—the Western railroad from Boston, which is to be like the *trunk* of a vast tree, with branches putting out in every direction, reaching into every northern and western State in the Union, yet like the branches of a tree all pointing to a common centre, which is BOSTON; and, like the tree whose sap descends in the autumn through the trunk to the roots, and ascends again on the return of mild breezes in the spring to the branches, so will flow a vast amount of business to and from that enterprizing and calculating city, which has hitherto, and would always have come to New York, if her capitalists, her business men, and her *politicians* had possessed a tithe of the public spirit and far reaching sagacity which has characterized the course of the Bostonians. Boston has never, like New York, made herself ridiculous by opposing every, or any public work which in the remotest degree would add to her business, or increase her wealth and population; but on the contrary, her citizens have been always ready both individually and collectively, to encourage and aid those in other places who were willing to risk their capital in the construction of public works *pointing towards* Boston; having the sagacity to see that no work of the kind could be put into operation without benefiting their own city. But how has it been, nay, how is it even *now* with New York? Have her citizens, with their immense wealth, with nearly as many *houses* and *ships* and *steamboats*, as Boston has inhabitants, given even a listening ear to those who for many years have labored and struggled to open an easy, direct, and *always* available communication with the interior; and sustained the few who at an early day projected the two noblest avenues that

could be constructed from her busy streets *north and westward*, to connect with the canals, (or, as her once leading citizens denominated them "*Clinton's big ditches*,") and with the vast lakes of the west? Never. A few, only of her intelligent and wealthy citizens have ever given these important works the benefit of their counsels and the aid of their means, and even many of these became disheartened, after having made a noble effort deserving a better result, and gave up in disgust at the appathy, the folly, or the short-sightedness of their fellow citizens; hence it is, that with a population of nearly 350,000, she can only *boast!* of a *single* railroad, built by her citizens, and terminating in her streets, of the *astonishing* length of—not like Boston with a connection or web of railroads of *twelve hundred* miles, but of—*about twelve* miles!!!

'Tis true her citizens have aided in constructing a number of railroads besides the Harlem road; there is the Paterson road of 14 miles, the Schenectady and Saratoga road a little longer than either of the others named, and the Stonington road, and the Long Island road, making a total of about *one hundred and sixty miles*, and perhaps they have aided in the construction of others at a distance some of which have not been completed, and where there was no possibility of immediate benefit to this city when completed, unless the city is benefitted by the game of shuttle-cock, so much played in Wall street with railroad stocks by a class of gentlemen who apparently grow rich by the game rather than by the produce of the roads.

Had sound policy and good judgment directed the expenditure of the capital invested by our citizens in railroads of comparative insignificance, we should now have the benefit of two main lines of railroad north and west from this city, reaching the Canadas and the great lakes, which would eventually have their numerous branches penetrating almost every county in the State, and other States, through which New York merchants and cartmen and owners of real estate would derive a large portion of the benefits of an immense business which will now find an outlet at Boston, and to which her citizens are richly entitled by their sagacity and public spirit.

The city of New York has been playing shuttle-cock with *fancy* stocks and politics, while Boston has labored at the *oar* and the *anvil* until she has spread herself all over the country, or brought the distant country to her very doors by means of her iron ways.

LOW FARES ON RAILWAYS.

The directors of the Boston and Providence railroad, have passed a vote to reduce the price of fare on the road on the 17th, one-third from the usual rate. The present price of fare from Boston to providence, 41 miles, is \$1 50. Reduced one-third, it will be \$1; or two and a half cents per mile. This rate per mile, may, we think, be safely assumed as the rate which will yield the largest revenue to railways in this country. If adopted on the railways from Troy to buffalo, it would reduce the price of a passage between the two cities to about \$7 50; which is indeed, the price now paid in the second class train, in which passengers are transported like cattle in long low boxes, with here and there an aperture to admit light and air, but no glass windows

to admit light and exclude air, when necessary. Should the several railway companies which control the railways from Schenectady to Buffalo, put these roads in first rate order, introduce the elegant and commodious cars used on the Schenectady and Troy, and on every other well managed railway, and reduce the fare in such cars or two and a half cents per mile; starting from every stopping place with the punctuality of a chronometer, * * * they would find their "account in it" at the end of the year. The travelling public would be far better accommodated than it ever has been between Buffalo and schenectady, and the proprietors of the roads receive larger dividends than they have ever received. At any rate, it is worth while for them to try the experiment. * * * If railways are to be allowed a certain monopoly, they certainly ought to be compelled to accommodate travellers in the *best* manner, and at moderate prices.

"Truth is mighty, and will prevail," and so will the system of "low fares" prevail, as the recent course of the Boston and Providence railroad company (an account of which we find in the Troy Whig,) indicates. *One dollar* from Boston to Providence will be found a fair rate, and **$7,50** or **$8** from the Hudson to lake Erie, should insure good accommodations, good attention, and punctuality in departure and arrival. Railroads are designed as much for the accommodation and comfort of travellers, as for the benefit of capitalists and stockholders, and the increase of the former will be surely found to promote the interests of the latter.

RAILROADS IN ILLINOIS.

A correspondent of the Cincinnati Gazette, travelling in Illinois, describes the only railroad in operation thus:

"I arrived at Springfield from Jacksonville, by railroad, distance 36 miles. This road runs from Springfield to Meredosia, on the Illinois river; the whole distance is about 55 miles. They have a locomotive which leaves Springfield every other day, and Meredosia alternate days, Sundays excepted. They have a tolerable pleasant passenger car attached. The fare is **$3,50** the whole distance; the trip occupies the greater part of the day, stopping both ways at Jacksonville to dine. This is the only *finished* railroad in the whole State, and it is in a miserable condition—so much so that no calculation can be made as to the time the cars will arrive; they generally say, "about such a time, if no accident occurs." The day I travelled on it, they ran off the track by means of one of the iron bars being loose and inclining in towards the centre of the track; not much damage was done. In some places the iron is torn off the rails, and remains off, and they have frequently to stop and get out to hold the end of the rail down while they run over it. The road is now in the hands of a company who have leased it for two years, for which they pay the State **$10,000**. Much prejudice exists against it. I could always read a paper or book while riding in a railroad car, but in this instance I had enough to do to keep my hat on. The people here, say this 55 miles of railroad has cost the State **$11,000,000**—that being the amount expended on this kind of improvement, while all have been abandoned but this one short piece."

Well, if this apology of a railroad has cost the State eleven millions of dollars, the people have only themselves to blame for it. When the subject of internal improvements came up in 1832, and strenuous efforts were made by some of her citizens to obtain means to construct a railroad, or canal

from the lake, at Chicago to the navigable waters of the Illinois, and thus open an easy and cheap communication through the State and make it a great thoroughfare of business and travel, the selfishness of the people would not consent to such a measure unless there could be—as in another State we could name—a grand system laid out to pervade the whole State, that all might enjoy equal privileges. In short, every man, or at least every member of the legislature, desired to have a city or a village on his own farm, that he might become wealthy at once; and hence, a large number of routes were projected, laid out, commenced, large amounts of money expended and then abandoned; and now complaints without number are heard from the very persons who caused, or did not prevent, such wastefulness, such folly. Illinois should have followed the example of New York in her early days of internal improvement. She should have constructed her *great* work through the State that other people might pay her tribute for passing and then have rested. A State can no more waste her means with propriety on visionary schemes than an individual, nor can she be justified in undertaking to construct works of doubtful utility merely to quiet a set of selfish individuals that they may not oppose works of vast public benefit.

RAILROADS IN INDIANA.

By the following paragraph from the Indiana State Journal, we learn that the company organized to complete the railroad from, as we suppose, Indianapolis to Lafayette is making some progress. This road was originally designed, we believe, to connect Michigan city with Indianapolis, and to be continued southwardly to Madison on the Mississippi river. We have had very little information of late in relation to the railroads and canals of Indiana. Will some friend of those works and of the Journal furnish us with an account of their present condition.

The Railroad.—By a letter from the president of the company, we learn that the cars have commenced running to Scipio, and that that place was to be the depot from last Monday week. In about five weeks the cars will run some 7 or 8 miles further north. The company, although not a year organized, have expended rising $80,000 on the road, and have nearly completed 17 miles; part of the grading of which, however, had been previously done by the State. We understand the company to be still going ahead, and in fine spirits.

The Troy Whig says the number of passengers carried over the Schenectady and Troy railroad during the week ending June 10th, was 1932; averaging 276 per day, Sunday inclusive.

Hartford and New York.—The fare between Hartford and New York, by railroad, and also by the river, has been reduced to two dollars and fifty cents;—*fifty cents too high still.*

New Railroad Project.—A correspondent of the Boston Daily Advertiser submits various statements to show the feasibility of building a railroad from Montreal, passing through Sherbrooke, L. C., Lancaster, the north of the White Mountains and Conway, to Great Falls N. H., connecting at the latter place with the railroads to Boston.

To the Stockholders, Directors and Officers of Railroads—to Civil Engineers, Inventors of Railroad Machinery, Dealers in Railroad Materials and Mathematical Instruments—and to the Editorial Corps generally—

The undersigned, proprietors of the American Railroad Journal, take this means of representing to those interested in the success of railroads and internal improvements generally, the advantages afforded by their work as an organ of communication with each other and the public, and also as an advertising medium—this being the only work devoted to the subject in the country—having been from its commencement favored by the communications of some of our most distinguished Civil Engineers and by the advertisements of several of the most successful manufacturers, inventors of improvements in railroad machinery, and dealers in railroad iron in all its forms.

Being desirous of bringing the work within the means of all who wish to avail themselves of its pages, they have obtained new type of smaller size, and thus are able to give three-fourths as much matter in *half* the number of pages, for two dollars a year; and as its circulation increases, we shall increase the quantity of reading, and *reduce* the price, hoping by this means to increase its usefulness, and give additional interest and value to the work. It is the only means by which advertisements in a single paper can reach those interested in railroads in widely distant parts of the Union, and it is designed to include *all* such persons among its subscribers.

TO DIRECTORS AND STOCKHOLDERS OF RAILROADS—

We need not say that the greatest ignorance has hitherto prevailed among people generally, in regard to the profit of railroads, and their character as an investment. It is true that, in many instances, where railroads have been constructed to benefit particular places or persons, without regard to other circumstances, the stock has not been found profitable, though even here in some cases, the value of property has been increased in amount equal to the entire cost of the road, but in almost every case, if not in *all*, where railroads have been *judiciously* located, *economically* constructed and *well managed*, they have proved good investments, and we do not hesitate to say that, within a few years, when those railroads now in course of construction, shall be completed, and others made to connect them with each other, and with canals and navigable waters, and further improvement of machinery now in rapid progress, shall be accomplished, railroad stocks will be found the safest, the most productive, and the favorite mode of investment. Even now, every mile of railroad completed, adds additional value to the thousands of miles already in use. Correct information only is required by the mass, in relation to the causes of failure, as well as to the true state of the case where works have been properly constructed, and are judiciously managed, to elevate the character of railroad stocks to the position they are designed to occupy. And how can such information be generally disseminated, you ask, to which we reply *circulate* the *Railroad Journal*

widely, and thus enable us to collect, digest, and arrange in tabular form the results of all the experience on the different roads in this country, and Europe, which will enable each company to adopt the improvements and avoid the errors of their neighbors, and to introduce economy and method in all their operations. As evidence of our desire to aid in the dissemination of correct and useful information, we propose to send to railroad companies and others interested, 25 copies of the Journal for one year, in one package, for $30; and to advertise one square on the cover for $8 a-year, and longer advertisements in proportion, thus giving the Journal and a yearly advertisement of a square for $10 a-year. Will you not, then, aid us in extending its circulation? and thereby promote the *general cause — your own and our interest?* We shall see.

TO CIVIL ENGINEERS.

The profession of Civil Engineers not having been organized into a society or institute, in this country, has as yet no official organ of communication with each other, or with the public generally. Meanwhile, the pages of the Railroad Journal have generally been resorted to for this purpose, and for a period of *several* years a good proportion of the professional papers which have been published have appeared therein. The circumstances of the times having made the necessity for such an organ greater than ever, it is respectfully urged upon Civil Engineers generally, to favor this work with articles of information, or discussion, on some of the important topics upon which it is desirable to obtain an exchange of opinion. When cuts or diagrams are necessary to illustrate their subjects, if not too costly they will be procured at the expense of the proprietors. As one, among many reasons for favoring this work, we may mention that the important subject of the employment of professional labor upon many legitimate objects other than railroads and canals, can be successfully advocated only in this Journal. It only remains for Civil Engineers themselves to decide whether a vast field of usefulness and profit to themselves and to others be opened or not.

TO MANUFACTURERS OF LOCOMOTIVES, STEAM ENGINES, RAILROAD MACHINERY AND MATHEMATICAL INSTRUMENTS,

This work affords a ready means of announcing their improvements to railroad companies, and also of advertising. It is well known that the newspapers of the day are seldom resorted to for advertisements of this class, and some mode of supplying this deficiency should be obtained. It is the intention of the proprietors of this Journal to make it the proper vehicle for all such notices—and we may confidently say that through its agency the reputation of our locomotives in Europe was first made known.

It is respectfully requested that manufacturers will communicate to us for publication, the peculiarities of their works, with a list of such engines as they may have constructed—particularly marine engines, with the dimensions and name, etc., of the steamers.

The performances of new engines, frequently, do not receive the credit they really deserve, because they are vaguely, and often incorrectly repre-

sented in the public journals. If such performances are well attested and presented for the consideration of those interested, it will certainly afford the best recommendation of their value, and the notice of the press generally can easily be obtained by means of the extensive exchanges of this Journal.

TO INVENTORS, PATENTEES AND DEALERS IN RAILROAD IRON AND MACHINERY,

We may hold out the same inducements. The want of success of many valuable improvements may be traced to the difficulty of obtaining access to persons interested and who are scattered over the whole United States. To all such, a ready communication with civil engineers and with railroad companies must prove highly useful.

TO THE GENTLEMEN OF THE PRESS.

We call upon the conductors of the Press throughout the country, who direct *public opinion*, that powerful machine, which only in this country, can carry forward important public improvements, to take a more active part in the collection and publication of local information in relation to works in their own vicinity, that we may be able to collate, condense and arrange the whole, and return it to them in convenient form for re-publication; and thus enable the people in every part of the country to know the extent, the character and the *benefits* of the system in the United States. And we respectfully ask them to copy more liberally from the Journal, and to call the attention of their readers to it, as a medium through which to obtain information in relation to the subject, and to send their paper in exchange.

GEORGE C. SCHAEFFER,
D. K. MINOR.

WOODEN PAVEMENTS.

We have always given our testimony in favor of this improvement. But it, like many other inventions, has had an undulating road to traverse in its ascent to permanent fame—at present it is on a descending grade, but gathering impetus to reach, by the aid of a good head of steam, and some stout pushing from it friends, a still higher level.

There are persons always ready to oppose everything, not of their own invention; but in spite of these, the improvement gained ground, until it was injured, as inventions sometimes are, as well as individuals—by their friends. This was done by the thousand and one patents which were taken out as soon as wood paving became somewhat the rage. We have from time to time noticed some of these; but a proper introduction to the whole, would be some dozen pages of solid geometry; and a suitable conclusion a disertation on the misplaced ingenuity of inventors. How many of these blocks were ever cut, is beyond our comprehension. In fact, we do not believe that a tithe of them ever was made; or if made, it would require a professor of mathematics to put them down. The contest between these various patentees, each abusing every plan but his own, had a tendency to throw all into disrepute.

The next difficulty was the question as to the durability of wood in this situation. Here the interests of rival patentees again led to erroneous opin-

ions as to the value of wooden paving, and various unfair, and even untrue statements of the decay under the different proportions were widely circulated; as far as our own observation extends, we are satisfied that much of the blame attached to this system of paving, belongs to the imperfect manner in which the work has been done, rather than to anything peculiar to the material or its form.

Recently the whole system has been decried on the occasion of the taking up of a pavement of this description in the upper part of Broadway, in this city. This was precisely what we predicted at the time, and had the intention been to throw into disrepute wooden pavements in general, no more effectual means could have been taken than were adopted in the construction of this specimen. In the first place, the blocks were not made true to the figure required, and the wood was unprepared. Secondly, the blocks were merely *laid* in their places without being either wedged or driven together; and to crown the folly, the blocks were not lifted by hand, but in the following novel manner: a smart blow was struck upon the upper surface by the edge of a sharp hatchet, if this penetrated to a sufficient depth, the block was raised sticking to the hatchet, and if not, the blow was repeated. By these means a series of indentations was made on the surface, and cracks caused throughout the block, which operated no doubt greatly to the preservation of the wood. Through the interstices between the pieces thus *openly* disposed, the wash of rain storms and the filthy water of the gutters found a ready channel until filled up by a mass of decomposing matter, operating as so much ferment to set the whole mass rotting. We doubt whether any *fungous pit* on the large scale was ever more ingeniously contrived.

The first trial of wooden blocks ever made on this side the Atlantic, was an advance, if we are not mistaken, of any similar pavements in England. Although without any preparation but a superficial coating of pitch after the pavement was laid, these blocks, though somewhat uneven, are yet, after the expiration of *eight* years, less unpleasant to pass over than the oft repaired ordinary stone pavement in its vicinity. We have before mentioned that this is in one of the greatest thoroughfares in the city.

Had these blocks been properly *Earleized* before they were put down, we have no hesitation in asserting that they would have remained up to this moment in perfect order. *Kyanizing*, if ever useful, is certainly out of the question in this case, by reason of its costliness.

If any more attempts at laying this kind of woodway are to be made, and we are satisfied that they will be made, let all proper care be taken in securing a good foundation—let a figure of the blocks be mathematically correct, (and this can be more readily and economically done by a simple machine contrived for the purpose, than by a single circular saw,) let them be *Earleized*, and lastly, let them be closely wedged together so that no interstices can be seen, then a coating of hot pitch poured over the whole and sprinkled with sand; and a pavement will be produced superior to any ever laid—nearly, if not quite as durable as ordinary stone paving, which requires frequent re-

pairs—as pliant and smooth as the finest turf, and we doubt not in the end as cheap as any other.

ACCOUNT OF THE SOUTH CAROLINA RAILROAD.

We extract from the last semi-annual report of this company, the following interesting account of their road. The history of this work contains a page from the history of the locomotive in the United States, or in fact in the world. It will be seen that the first engine built for this company, was constructed by Mr. E. L. Miller, now of this State. Mr. Miller was, at that time, a director, and on his return from a visit to England, where he had seen the best locomotives then built, he was so fully impressed with the vast capabilities of the locomotive engine that he urged the construction of one, and without any one to favor his views at first, he soon made converts to his side of the question. Mr. M. even had a small working model constructed at his own expense, in order to convince the citizens of Charleston that this was the best form of motive power for their road.

We are informed by this gentleman that this was not the first locomotive *built* in this country, but the first which ever was able to perform.

AN ACCOUNT OF THE ROAD.

In the fall term of 1827, Maj. Alexander Black on his own responsibility, at the suggestion of a friend, obtained the charter of the South Carolina canal and railroad company, and in doing this was permitted to address the senate to get the bill through that body, there being no one in the senate sufficiently acquainted with the subject, (he being a member of the house.)

This Charter was materially altered and amended at the extra session of January, 1828, making the capital $700,000, and to secure this Charter 3,500 shares of $100 each was required to be subscribed at the first opening of the books, (6 weeks after the passage of the act,) namely, on the 17th March, and to remain open until the 21st of the same month. On the 21st of March, 1828, at 9, P. M., the whole amount was made up, and ten dollars on each share paid, amounting to $35,000, all in Charleston, not a share taken at Hamburg, Columbia or Camden, where books were also opened.

This amount of capital was all paid,	$350,000
And the books were again opened for	250,000
And again in 1833, for	300,000
And again in 1835, for	300,000
And finally in 1837, for	800,000
In all	2,000,000

And at each opening there was an over subscription by the original subscribers and their assignees, after the first subscription the books were never again opened to the public.

In the progress of the work, application was made to the legislature for $250,000, only $100,000 was granted, but this on liberal terms, 7 years, and interest at 5 per cent., payable at maturity of bonds. This has since been extended ten years more, to 1847, when the amount and interest will be due. The charter required that the road should be commenced within two years after the first subscription to the stock, and be completed for transportation within six years of that time. 1,000 tons of iron were imported immediately, and little more was done except making inquiry on the subject, and surveys on the line. Examinations of the country were made by Dr.

Howard, U. S. Engineer, and by Horatio Allen, Civil Engineer, who made the location; and on the 9th January, 1830, commenced the work at Line street, by driving piles of light wood, 8 by 8 inches square, 6½ feet apart along the line, and 6 feet apart laterally, caps or ties morticed on the piles 6 by 9, 9 feet long, and rails same size, notched on to these ties and wedged on the inner side. This construction was continued through nearly the whole line. When the work was over 15 feet high, three piles abreast were driven, and a sill placed on them near the ground, which supported a framed work, (an inverted W) on which the ties and rails were secured as before described.

This work costing $2,000 per mile including materials, except iron, on the level ground, and $2,500 to $4,000 per mile, over swamps 10 to 20 feet high. The excavation was done at 6 to 10 cents per yard generally.

In 1830, six miles only were finished; in 1831, nearly the whole road was put under contract; and in October, 1833, the road was connected from Line street to Hamburg, 136 miles.

The road cost for construction and materials, except iron,		$584,542 43
Iron and spikes, and putting down,		125,309 47
		$709 851 92
Preliminary expenses and surveys,	$13,894 68	
Engineer department,	72,006 39	
Work shops and materials, negroes, etc.,	43,892 11	
Machinery, engines, cars and inclined plane,	76,523 89	
Land $13,950 82, road police $18,159 89,	32,109 71	
Office expenses to 1st Nov. 1829,	2,869 69	
		241,296 47
		$951,148 39

This road thus constructed with some alterations and improvements was kept up on *stilts* till 1836. Requiring then heavy repairs, and to be almost rebuilt, which was commenced that year by importing heavy flanged iron, now on the road, throwing up an embankment to support the piles and rails, and replacing timber where it was decayed.

This was continued through the years 1837, 1838, and completed in 1839 increasing the cost of the road and property of the company, in lands, buildings, negroes, machinery, materials, etc., as represented in the accounts, semi-annually reported by the secretary and treasurer, to $2,506,762 61, nearly $400,000 of this amount having been paid for from the income, rather than increase the capital to the cost of the road.

The grades on this road are very easy, not exceeding thirty feet in a mile, on the 120 miles to the inclined plane. That descends about 180 feet in half a mile, and beyond the plane a fall of 70 feet in two miles, or 35 feet per mile.

This inclined plane has been regarded a great mistake in the location of the road, as it might have been avoided by increasing the length of the road about six miles; but this would have made a continuous grade of thirty feet in a mile, where the trains would have been much retarded by frost, or when slightly wet, which is nearly bad as frost; and the cost of keeping up six miles of road on side hills, and having many curves, would have been more than the average of other parts of the road, and at the present reduced rates would probably exceed six hundred dollars per mile, or $3,600 for the six miles per year, which is very little less than the expense of the inclined plane; and passengers are passed over the latter with less delay than, (and without the expense,) on the six miles of road. The locomotive engine hav-

ing been substituted for the stationary, the expense is reduced about three thousand dollars per year, and is capable of performing more than has ever been required in a day, and almost daily making a trip to Hamburg, (16 miles,) besides doing the work of the plane. So the plane is not so objectionable as it was believed to be.

I would not be understood as recommending a steep inclined plane, requiring stationary or other extra power to overcome it, where it could be avoided at the maximum grade on other parts of the road. But having this plane, I would not recommend the abandonment of it at present, nor at any future time, unless a great increase of profitable business should render it more inconvenient than it now is, and warrant the cost of cutting round it.

HISTORY OF THE LOCOMOTIVE ENGINES.

Extract of a report by the Honorable Thomas Bennett, to the board, January 14th, 1830—five days after the building of the road was commenced.

"The locomotive shall alone be used. The perfection of this power in its application to railroads is fast maturing, and will certainly reach, within the period of constructing our road, a degree of excellence which will render the application of animal power, a gross abuse of the gifts of genius and science."

This was assuming a great deal, when animal power was used years after this, on all the other railroads then constructing in this country. But what then were our expectations as regarded the performance of a locomotive?—On the 1st of March, 1830, a committee reported that they had accepted the offer of Mr. E. L. Miller, to construct a locomotive engine in New York, at the West Point Foundry; and that she should perform at the rate of ten miles an hour, instead of eight as first proposed, and carry three times her weight, which was required the year before on the Liverpool and Manchester road, at the trial of engines for the premium of £500, which Mr. Miller went out to witness. Mr. Miller's engine, under the above contract, was brought out by him in the fall of that year, (1830) and on the 14th and 15th of December, had her trial, and proved her power and efficiency double that contracted for—running at the rate of 16 to 21 miles an hour, with 40 to 50 passengers in some four or five cars, and without the cars, 30 to 35 miles an hour.

This engine continued to carry passengers up and down the line until the road was finished; at one time going 72 miles out and back the same day—and carrying at one time 100 passengers. After the road was completed, this engine conveyed the passengers between Aiken and Hamburg for years, and probably ran as many miles as any engine ever built, and performed equal to any of her size, (about four tons weight.)

This was the first locomotive engine, we believe, built in the U. States, to run on a railroad—she was at first called the "Best Friend," but having her boiler burst in June, 1831, and renewed in Charleston—she was afterwards called the "Phœnix."

From 1836 to 1843, 4 engines only were ordered; 2 in 1837, and 2 in 1839; all from Philadelphia. 7 others were received in 1837 and 1838, of the 35 ordered above.

In the last two years, four engines have been built in the work-shops of the company, besides rebuilding several of those previously purchased.

The whole number, in the list annexed, (marked 8) is 44, purchased and built by the company, and are accounted for as follows:

19 broken up, (except 2 boilers rebuilt.)

1 sold to the St. Joseph's railroad company, and 24 in the present schedule.

Of these, 6 were made in Philadelphia, 10 in Charleston, and 7 in Eng-

land—including 1 of the Philadelphia, 2 of the English, and 2 of the Charleston, rebuilding, or to be rebuilt.

Preparations are making for two more engines like the Orangeburg, the first of our make; which performs so well—parts are cast and fitting, and will no doubt be finished for another season's business.

It will be seen by the foregoing statement, that four engines only have been ordered in the last six years, and none in the last three years. Yet the power has been kept up by building and rebuilding much more efficiently, than when six or seven were ordered annually.

THE PECULIARITIES OF THIS ROAD, ETC.

The construction of this road on piles is becoming more in favor with others, as well as those having the advantage of it. Several roads at the north are partially on this plan. The New York and Erie railroad to be 446 miles long, is to be about one-half, built in this way. Over 70 miles of piles have been already driven.

It saves much of the cost of embanking a road by being able to transport the earth upon it to fill the valleys and swamps, and before it is necessary to do this, the income of the road is providing for the payment while it is constructing.

It preserves the line and level of the road after the embankment is made; when roads are built on fills and cuts without piles, the superstructure is continually liable to be disturbed by the sinking of the banks, or water settling in the excavations, much to the injury of passing trains, frequently breaking axles, and otherwise deranging the machinery of the engines.

The large wooden water-courses through the road are much more safe, and give less trouble than those made of brick or stone, unless very large, and foundations well secured, which has been difficult to attain in some of the late constructed works. The cost of the wooden-culvert is less than the interest of the cost of those built in masonry, and they can be kept in repair for one-fifth their first cost annually.

The flanged iron, now on the whole of the main track, weighing about forty tons to the mile, gives no trouble; a less number of bars have failed since first commenced putting it down in 1836 than have been condemned in the first year of the best edge-rail on other roads, although the latter are decidedly preferable where timber for rails cannot be readily and cheaply obtained.

The frequent turn-outs every four or five miles, answer nearly all the purpose of a double track, while the first cost and expense of repairs of a second is saved.

The lateral sections for supplying *wood* to the tenders, keeps it off from the road, lessening the risk of fire and gives despatch in receiving it.

The contracting for the wood cut and hauled in lengths to feed the engine, avoids much trash that would be caused by the chips and bark that would be collected if cut at the station.

And by having the wood corded or piled for measurement by the *station man*, he is made responsible for the quantity and quality in each cord.

The barrel cars, found only on this road, contribute largely to the economy of transportation; these, both for passengers or freight, cost about half the expense of the square car of the same capacity, are much more durable, and require less repairs, and if thrown from the road are not so liable to be broken.

This was lately tested, by the rolling off of one down a hill, several rods, loaded with cotton, without starting a joint. In putting it on the road, however, by the carelessness of the workmen who did it, several staves were

broken; advantage was taken of this by proving how readily and cheaply it could be repaired. The broken staves were replaced with new ones at a trifling expense. When a similar accident happens to the old formed cars they are generally so much broken as to be unworthy of repair.

The new arrangement of the interior of one of the barrel cars looks awkward, and is frequently condemned by strangers at first sight, and some are resolved not to be reconciled to it. The warm weather will show the advantage of this plan when the windows are required to be open—the passenger is kept more out of the dust, fire and sun, than by any other arrangement of the seats. The cushions are more easily kept clean, and being in the centre, are warmer in the winter and cooler in the summer. The seats, back to back, give more room under them for small baggage, and the rails and shelf over the backs are for light articles, such as too frequently occupy half the seats in the other cars.

VISIT TO MR. BURDEN'S IRON WORKS, TROY.

We find the annexed account of a visit to the Iron Works of Mr. H. Burden, near Troy, in the New York American, of 24th May—from the pen of its able and observing editor, Mr. Charles King. A recent visit by one of the editors of this Journal enables us to add a few additional particulars to his vivid account, which may possibly aid in a clear understanding of this establishment.

The fall of water, within 35 rods, is about 53 feet, which enabled the ingenious proprietor to exercise his mechanical skill to some purpose. His supply of water, on the ordinary sized wheel, would not carry the half of his present machinery—which, by the bye, is but a small portion of his ultimate aim—and, therefore he has constructed a wheel of 51 feet diameter, with 21 feet length, and 8 feet depth of bucket; in which 70 to 80 tons of water may be contained without overflowing—thus giving him the control of power in reserve, very far beyond, perhaps *double* his requirements, when all his present machinery, employing over 250 persons, all told, is in full operation.

This wheel is indeed a curiosity. Its equal has not, that we can learn, yet been constructed. With the exception of the buckets, it is entirely of iron. The shaft is of wrought iron, and in two parts, being about 16 inches diameter at the journal ends, and 10 inches where it comes together, within a collar, at the centre. Upon this shaft are four cast iron rims of about 4 feet diameter, with flanges so constructed as to receive the *arms* of the wheel which are wrought iron rods, $1\frac{1}{4}$ inch diameter, 23 feet long, and about 500 in number, passing through the flanges on the shaft, and made fast by two nuts. To the outer ends of these rods the periphery, or bed of the buckets, of 6 inch pine timber is made fast with nuts, by which this immense mass of material can be adjusted to an accuracy of movement truly astonishing, and it is so perfectly balanced that it is scarcely heard; and so tight and well preserved that the inside of the wheel is kept dry, not a drop of water nor a wet spot could be seen on the inner surface.

The pit for this immense wheel is excavated from a slate rock to the depth of 25 feet, and from the deepest part of it a tunnel is excavated through the

same rock into the natural bed of the stream below, for the discharge of the water. The average revolution of the wheel is about 1¾ per minute, or 105 revolutions per hour. There is a rack on each end of the buckets working into pinions 22 inches diameter, on different lines of shafting hundreds of feet in length, one of which operates a large number of nail machines, another a long line of spike machines and the famous horseshoe machines, and a third moves the immense balance wheel of 20 tons, and the ponderous machinery for making iron from the pig into all sorts and sizes; and blows the bellows for the puddling and other furnaces.

There are three great curiosities in this establishment even to those who are familiar with the process of making iron into its various forms, and then into nails and spikes—the wheel, the "iron whirligig" and the horseshoe machine. The like are not to be found elsewhere in this country.

Mr. Burden estimates that his wheel is competent to drive machinery sufficient to employ over a *thousand* persons, men and boys, as they are usually employed in similar establishments, though he has not now over one-fourth that number employed, but we hope eventually to see it tasked to its utmost ability, and that the ingenious and enterprising proprietor may reap a rich reward for his years of persevering industry.

"Taking advantage of a flying trip," says the editor of the N. Y. American, "to Troy and of the civil invitation of Mr. Burden to visit his works, we spent an hour or two most agreeably among fire balls, fire bars and fire serpents of iron—all manipulated by men, and by machinery, like so many pretty and innocent play things.

"The works are situated in a wild ravine, worn out of a slate rock by a short and rapid natural stream called Wynant's kill, we think Mr. Burden said. This stream supplies the whole power of the machinery here employed, and the wheel which imparts motion to the machines of the respective work shops is in itself one of the grandest objects of the sort we ever saw.

"It is an immense wheel of 51 feet in diameter, as high as a three story house, and 22 feet wide, over which, into troughs hollowed out for its reception, falls a sheet of water so thin that but for the evidence of the senses, one would hardly believe an agent so comparatively feeble, could cause the ponderous wheel to turn with a momentum, that puts in play hundreds of other wheels and machines of different sorts.

"The channel way in which this immense water wheel turns, is cut out of the solid rock. The axle is of wrought iron, and from the flanges project hundreds of iron rods, that support the periphery of the wheel, and steady and strengthen the whole structure. In its grand, deliberate and majestic revolution, there is really much of the sublime; and when it is perceived, that from this single and simple power, vast combinations of machinery derive their motion, the feeling of admiration is yet farther excited.

"The destruction of confidence, the absence of a national currency, and the other effects of misgovernment which have cursed the whole country, ever since the political malignity of Secretary Woodbury, aided by the political popularity and the unscrupulous will of Andrew Jackson, commenced a war upon the national currency—have of course been felt in these extensive works, and but few persons, comparatively, and portions only of the shops, were employed. Nevertheless, the various processes of puddling the iron,

of placing the misshapen glowing mass in a sort of iron whirligig, (a recent invention, by the bye, of Mr. Burden, the patent for which, for England, he has sold at a round sum,) which, by its rapid evolution, casts off all the *scoria* while, by pressure, it forms the mass into a square block, of drawing this block over and under successive rollers into long, flat iron bars; the rolling out, by like means, of the flexible, red hot iron rods, that coil their bright folds alarmingly around the spectator, like so many living and literally, as now and then they come in contact with water, hissing serpents; this, and much more, we witnessed with great satisfaction, though not without a certain sense of bewilderment at the astonishing regularity with which everything proceeded amid a din and what seemed confusion unspeakable. A son of Mr. Burden, an intelligent young man, and a thorough workie, like his father, is superintendent of this department.

" Thence we proceeded to other shops. In the first was a row of lads sitting before sharp biting machines, within whose maw they continually thrust thin blades of cold iron, and which these reasoning and calculating machines convert as rapidly as thought, into nails pointed, headed and squared, ready for use.

" In another, a spike shop, this process was repeated on a larger scale; for there, thick square rods of red-hot iron were thrust into the machines, which by one simultaneous action, cut them off in the requisite length for spikes, headed and pointed them, and dropped them out below.

" No other human agency is requisite to either of these machines than simply to furnish the raw iron, and remove the finished fabric; the intelligent mechanism does all the rest.

" The most curions of all, however, is the more recent invention of Mr. Burden for making horse shoes. Two machines are required for this work, and a boy to assist the process. In the first, the iron in thin bars is put in, grooved and pierced with holes for the nails; in the next, it is flattened by pressure, and then rounded to the precise form of the hoop. Shoes of all sizes are thus made, and with unerring accuracy. Moreover, as the nail-holes are all punched upon an accurate calculation of the average thickness of the horny part of the hoof in which the nails are driven, there can be no possibility, even with a drunken or ignorant blacksmith, of pricking the horse, because the nail can only take the direction indicated by the hole. This is, in itself, a decided superiority in these shoes; for every one who has kept horses, knows how liable the noble animal is to suffering and lameness, from the holes of the shoe, punched by an unskillful blacksmith, being too far within the rim, and consequently conducting the nail into, or close upon the quick, instead of into the horn.

" Another advantage is in the great toughness of the iron thus fashioned by machinery; for none but the toughest would bear the strain.

" The price at which Mr. Burden can sell these shoes is greatly below that at present paid, and we hope soon to see them in general use.

" From these lower regions of Mr. Burden's dominions, we ascended to the upper air of his fine residence, on the hill, surrounded with beautiful trees and shrubbery, superb gardens, and commanding a view up and down and across the Hudson, of great beauty.

" Here, after the day's work, Mr. Burden is as retired from his factories, though lying directly beneath him, as if miles away; and we confess the satisfaction with which we witnessed the taste and comfort that surronnded the dwelling of this self-made mechanic.

MILK AND RAILROADS.

A queer juxtaposition—but no fiction for all that. The time was when some wag proposed the introduction of milk into our large cities by means of an open canal, but the age of canals has in a measure passed away The next suggestion was, that of a covered aqueduct and the final distribution by pipes. This was too costly a plan and the pipes would have interfered with those for the distribution of Croton water in New York at least. But this is the "iron age" of railroads, and they have successfully accomplished and daily perform the task of the introduction of pure and wholesome milk into our city.

We suppose that the character of suburban milk is pretty well known, at least in New York. Water is the chief ingredient—starch, magnesia, and similar substances are added to give what the painters call body. The milk from the cow, which enters in a small proportion into the compound, is perhaps not quite so bad as it is usually represented, though we must confess that the cows are fed on most villanous stuff, which would be rather out of place even in the hog trough. We remember some curious details of the milk trade related by a worthy clergyman of our acquaintance, who happened to fall in with a milkman while at the pump. The fellow being of a frank disposition, cheerfully communicated many interesting particulars of a "professional" character. Among others, he stated that unless a certain quantity of water were added, he could find no purchasers for his milk, as from its color and consistency he would be suspected of adding the refuse of the starch factories!

We put these things on record for the benefit of future antiquarians—they already belong to the history of the past. At this moment pure and wholesome milk is sold all over the city at four cents per quart—the price for the composition above named was six, undoubtedly owing to the cost of the materials. This wonderful revolution has been wrought through the agency of the New York and Erie railroad—and affords a fine example of the benefits of railroads. This may be thought by some a small matter, but it is far otherwise, for, sometime since, we were informed that, if the milk business were to continue as it had commenced, it would be found necessary and profitable to run for its accommodation a special train.

The following is the mode in which the transportation is performed, as related by a resident of Orange county, in the Cultivator:

"The cows are milked early in the morning at Goshen and its vicinity, the milk put into cans containing from 60 to 75 quarts, into which a tin tube filled with ice is inserted, and stirred until the animal heat is expelled from the milk. It is then sent by the railroad, and arrives, a distance of 80 miles at the milk depots (which are numerous in the city,) in four and a-half hours. The tube filled with ice is again inserted, and the milk thus kept cool and sweet until sold. It can be afforded to the public at four cents per quart, of which the farmer gets two cents per quart and is well satisfied, as it yields more than butter at twenty-five cents per pound."

Here we find that three parties are benefited. The farmer makes a pro-

fitable disposition of his milk—the railroad company receives a handsome freight and the public a pure and at the same time cheap article. Not only so, but this milk is sold in the city of Brooklyn, the very head quarters of the milk factories and with the whole of Long Island "the garden of New York" at its back.

After this, who can say that railways are not destined to add to the comforts and luxuries as well as to the necessities of life—or who can say that the city of New York has yet began to realize the benefits it will derive from being, at *some* distant day, the centre of a web of "judiciously located and well constructed" railways.

Cheap Travelling.—Those splendid steamers, the Troy and Empire, now carry passengers from Troy to New York for 25 cents, and sometimes for 12½ cents. No one can find any fault with this price but the proprietors. So much for "chartered monopolies."

We take the above paragraph from the Troy Whig, and regret that it had not been accompanied with a word of disapproval by the editor of that excellent paper. This competition, ruinous as it must be to the proprietors, is also injurious to the community. It leads people *from home*, because it is, the say, cheaper to go than to remain, and many into other expenses which they cannot afford. The prices for passage should be fixed at reasonable rates to those who must travel, but at the same time at rates which will compensate liberally those who invest their capital in such boats, and provide such accommodations and excellent officers as are found in the above named boats and in the boats of the Peoples' line on the Hudson. We refer, not invidiously to, but because we have known them personally for years and can say confidently that more competent and careful men cannot be found in the business, than in the commanders of the boats referred to.

Western Railroad.—Receipts for one week, June 3d,

1843,	$12,008
1842,	9,972
Increase,	2,036

Total increase in May, $10,105, being over 25 per cent.

The result, in part, of the adoption of the system of "low fares." One unacquainted with the operations of a *business* railroad, i. e. on which all kinds of *freighting* is done, will hardly believe the assertion that a drove of 1500 live hogs were carried over the Western railroad a few days ago, in 16 cars in one train, and 50 head of cattle were also to go in the same train. As many as 3000 hogs have been taken over that road, in one train, we were told, when at the Greenbush depot for a few minutes, a short time since, and at an expense of course little greater than their feed would have cost while travelling to Boston. Thus it is that *Boston* steps in between New York and the western business, and says "after us, gentlemen, you can *help yourselves* if you will;" may we ask when, *when will* the citizens of New York see and feel the necessity of helping themselves?

NATIONAL INSTITUTE.

At a late meeting of the institute, Capt. Geo. W. Hughes, of the topographical engineers, made the following remarks on the subject of the stone of which the great Plymouth breakwater is constructed, specimens of which have been presented to the institute by T. W. Fox, consul of the United States at Plymouth:

"In listening to the reading of the record of the proceedings of last meeting, one item especially arrested my attention, in relation to which I beg leave to offer a few observations. I refer to the letter of Mr. Fox, of Plymouth, in which, after expressing a deep interest in the success of the National Institute, he informs the corresponding secretary that he has shipped for our cabinet a large specimen of the stone used in the construction of the breakwater at Plymouth—one of those stupendous works, combining the useful with the grand, for which his government is so justly celebrated, and which may be said to mark the difference between the utilitarian structures of modern times and the gigantic but useless and unmeaning works of remote antiquity. The dimensions of the breakwater are as follows: Breadth at base, 410 feet; ditto at top, 95 feet; breadth of front sea-slope, 85 feet; ditto inner or land-slope, 110 feet; average breadth of fore-shore, 65 feet; breadth of outer sea-slope, 108 feet; length at the base, 1800 yards; ditto on the top, 1700 yards; average height 42 feet. It is nearly finished, and when completed will contain about 3,500,000 tons of stone, at a cost of nearly £1,500,000, including the accessary works.

"All the rock employed in the structure, with the exception of about 100,000 tons of *cut* granite, is a *limestone* (abounding in *madrepores*) from the Oreston quarries on the cutwater near Plymouth. The weight of a cube foot of this stone is 168 lbs. or $13\frac{1}{3}$ cube feet to the ton. When the late Mr. Rennie undertook this work he considered it as a matter for congratulation that so *enduring* a material as the Oreston limestone could be procured with so much facility; but subsequent experience has shown that that eminent engineer was in great error in reference to its durability in salt water, owing to the ravages to which it is exposed from the attacks of a small *shell-fish*, which perforates it in all directions, and gives to the stone a *honey-comb* ap-appearance, not unlike that of wood bored by the carpenter bee or by the sea worm. This enemy of the limestone is called the *saxicava rugosa* of Lamarck, or *mytilus rugosa* of Linnæus. It belongs to the genera Lithophaga, section C, Termipeda, first order of the 11th class, conchifera, of Lamarck, who thus describes it: "*Lithopaga*, third genus; boring shells, without accessory pieces or sheaths, and more or less gaping at their anterior side; ligament of the valves external. *Saxicava:* shell bivalve, transverse, inequilateral, gaping anteriorly at the superior margin; hinge almost without teeth; ligament external. The *petricola* pholadeformis belongs to the same genera." The saxicava generally attach themselves to the blocks of stone between the bottom and the line of low water; but they are sometimes found above that level. They penetrate the stone to the depth of five or six inches, and when this portion becomes abraded by the action of the waves, they bore still deeper into the rock. By this process, this immense work is slowly but certainly crumbling to decay; and it is stated, on semi-official authority, 'that hundreds of tons are destroyed by it (the saxicava) in every year.' They adhere to the limestone in thousands, at first not longer than a pea, but, as they bury themselves in the rock, increase in size till they attain half an inch in diameter. It seems doubtful if they feed on the material of the rock, as they put out their feelers from the holes to catch such food as may be floating by.

"The quay works of the dock-yard at Devonport, built of Portland stone, has also suffered from the ravages of this animal.

"It is not to the loose stones alone that the saxicava adhere, for they likewise attach themselves to the native rock below the surface of the water; and it is said, 'that their operations have been so extensive as to deepen the water in some places several feet. I have, in walking along the beech of Plymouth sound, picked up stones which had been perforated and detached by the active agency of these persevering conchifera.'

"The *modus operandi* by which these animals bore into the solid rock has been the subject of much discussion. That it is not by eating or gnawing into it is rendered pretty certain by their soft bodies and fragile shells. Dr. Buckland supposed that the holes were produced by the action of an acid secreted by the animal; but to this theory it may be objected that no acid has been found it it, and that if there were it would be as likely to act on its own shell as on the limestone. To this latter objection it might be replied that, perhaps, the *vital principal* would resist this action. Professor Sedgewick suggested that the animal probably effected its lodgment by the rapid agitation of water in small vortices. We know that rocks in running waters are frequently pierced by a similar agency.

"I have recently seen, in the cabinet of Mr. [illegible]uff, of this city, a fragment of a limestone rock from the vicinity of Gibralter perforated by the action of a shell-fish, the shel[illegible] of which are contained in the cavities. But the saxicava must not be confounded with the *date fish*, so called from its resemblance to that fruit, found in the limestone mud of the Mediterranean, which becomes on exposure sufficiently indurated to form a good building material.

"It may be of some consequence, Mr. President, that these facts should be known, especially to the architect and engineer, and this must be my apology for trespassing so long on the time of the meeting. It would appear, from the stat[illegible] [illegible]t the only materials which can be used with absolute safety in su[illegible]e structures are granite, greenstone, basalt, or some other stone [illegible] has been previously fused."

NEW METHOD OF SENDING PORK TO MARKET.

We find in the Troy [illegible] the following novel description of sending *pork* to market. It is certainly an improvement, in point of economy, and still it will be vastly improved upon when the New York, and Erie and other railroads shall be co[illegible]pleted to the great pork region of our country. We shall then see *cars* constructed for that purpose and filled with the produce of the west *in bulk*, and brought to our market during the cold seasons, and thus not only save a vast expense in packages, but also give our citizens not only the benefit of *winter employment*, but also of constant new supplies, and of course regula[illegible] prices, during the winter—advantages to our citizens which alone w[illegible] [illegible] seven years the cost of a railroad from New York to C[illegible]

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"We saw yesterday at one of our docks a canal boat loaded with pork *in bulk*, shipped by W. Martin & Co., of Circleville, Ohio, by the Troy and Erie line This pork is cut up in the following manner. After taking off the head and hams, the remainder of the hog is cut into four pieces, which are first washed with a solution of saltpetre, and then sprinkled with salt. With no other preparation than this, they are shipped in bulk from Circleville to New York, where they will be packed and re-salted in the usual manner.

The lot of pork to which we refer, contained 55 tons, and looked as well as any pork we ever saw. By this new method of cutting it up, a great saving is effected in the cost of [illegible]; the quality of the pork being preserved equally well as when barrelled. This shipment will doubtless be followed by others of a similar nature."

TROY AND SCHENECTADY RAILROAD.

We passed over this road a few days since, and found it uncommonly easy to ride upon. On leaving the *Troy H[illegible]* after an [illegible] breakfast, we entered the car, which seems to have [illegible] view to cleanliness and comfort, being sustained by the [illegible]," and well ventilated. We were tak[illegible] by ho[illegible] the depot, and in a few minutes were attached to [illegible]y, at a rapid rate, notwithstanding the ascent, [illegible] was at the rate of 52 feet to the mile [illegible] to Schenectady, by the railroad [illegible] canal with its numerous boats [illegible]ing in [illegible] far to the north; the Mo[illegible]k with [illegible] among the hills and its aqued[illegible]ct for the [illegible] of [illegible]; and the far off green hills which are beh[illegible] constantly [illegible] views, will render this road fro[illegible] Yo[illegible] route. It will at least come in [illegible] of th[illegible] known. From the little opportunity we had to examin[illegible] to believe that it is well built, [illegible]ell found and *well* [illegible] *deserves* to be well patroniz[illegible]

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"The Boston [illegible] dividend of 3 per cent. for the [illegible]

We desire [illegible] dividends upon railroad stocks in the [illegible] officers of the different railroa[illegible] com[illegible] whenever dividends are declared, [illegible] and prospective [illegible] of suc[illegible] ill be found among the [illegible] prof[illegible]

"Please exchange" [illegible] "the number for July is received, [illegible] be received, and the money f[illegible];" [illegible] you will greatly oblig[illegible]

[illegible]

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 8, Vol. I. Third Series. | AUGUST, 1843. | Whole No. 427. Vol. XVI.

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BY W. R. CASEY, CIVIL ENGINEER.

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One proof of the want of waterway was as follows: two hours before the dam gave way the water was up to the coping of the parapet wall. A messenger was then despatched to warn the people below that the dam could not stand much longer; yet, half an hour before it burst away, the water in Bailey's mill pond, two miles below, was six inches lower than in previous floods. So that however great the flood may have been *after* the dam gave way, at that moment it had not reached ordinary high water mark, as in 1837 and 1839.

This was confirmed by the following surveys and calculations. No dams remaining across the Croton river, the dams on five of the six main tributaries were measured, and the sixth, on which there was no dam, was approximated. These dams vary in length from 50 to 107 feet, with a depth above the lip in time of freshets, of from 3 to 6 feet 10 inches. These streams are —commencing near the dam—the Kisco, Muscoot, Cross river, Titicus, East and West Branches of Croton.(1) The rise was taken from 50 to 100 feet above the overfalls, not only to avoid the depression which takes place for some distance above the lip, but, because in this case, it was the height to which the water would rise at the head of the masonry, about 90 feet above the lip, which was alone important. As soon as it reached the coping, the destruction of the dam was of course certain.

The height of the parapet wall between the waterway and the embank-

(1.) This calculation makes no allowance for the four or five times greater velocity of the water in the shallow mill ponds of the tributaries, as compared with the gentle flow through the Croton lake, 4 miles long and 30 to 40 feet deep, or for the greater ease with which the water reaches the overfall of these dams, nor does it take into account three considerable brooks and eight or ten minor streams —insignificant in droughts, but torrents during a freshet.

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DIVIDENDS ON RAILROAD STOCKS.

"The Boston and Worcester railroad company have declared a dividend of 3 per cent. for the last six months."

We desire hereafter to give an account of all declared dividends upon railroad stocks in the United States, and therefore will thank the officers of the different railroad companies to furnish us with official statements whenever dividends are declared, that we may be able to show the present and prospective value of such investments, which we believe will be found among the most profitable and the safest in the country.

"Please exchange" with the Railroad Journal, and if you will do us the favor to say that "the number for July is received, and may be examined at our office;" and that "subscriptions will be received, and the money forwarded;" and if you will even go so far as to copy the list of contents, you will greatly oblige the Editors, and aid the cause.

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ment is 12 feet above the lip, and the city engineers claimed an efficient waterway of 85 feet in width and 12 feet in depth! They also claimed as efficient waterway, after the water has risen 8 feet on the lip, the breadth of the platform leading into the culvert house! The writer considered 80 feet as very liberal, and doubts whether many engineers could be found who would consider this dam as equivalent to one with 70 feet lip, at right angles to the current, and with skilfully projected or even decent approaches so as to make the dischage something near a maximum. The area claimed above, whether as regards depth or breadth, requires no refutation beyond its mere statement, it being hard to say, whether narrowing the waterway of a dam 40 feet high, so as to have 12 feet on the lip in freshets, and the water flush with the upper surface of the parapet wall, shows less acquaintance with practical engineering, than does the claiming, as efficient waterway, the width of the platform, below the culvert house, prove ignorance of the principles of hydraulics.

Now the measures of these various streams for 1839, when reduced to a lip of 80 feet, gave a depth of 12·8 feet; to 85 feet, 12·6 feet; to 75 feet, 13·4 feet. It was objected to this mode of calculation that the tributaries do not reach their maximum at the same moment—an objection of course foreseen and to which the equalizing(2) effect of the 400 acres of the Croton lake and the circumstances detailed in Note 1 were considered a fair offset. But the object of course was to obtain the relative not the absolute rise, though it will be seen, that even this latter was very closely approximated. With reference to the former the objection vanishes.

This mode was adopted in 1841, and the flood of 1843 gave a good opportunity of testing its accuracy. The measurements of the flood of 1843 gave a depth of 13·4 feet on 80 feet=12·9 feet on 85 feet=6 feet on 269 feet. The *actual* height was given as about 6 feet on the new dam 251 feet long, or adding the discharge through the culvert and aqueduct,=a lip of 258. From observations made the morning after the flood, the writer has much confidence in stating the depth at 6·33 feet. The flood of 1841 was calculated in the same manner, and gave a depth of 14·5 feet on 85 feet lip. So the floods of 1839, 1841 and 1843 are to each other as 1, 1·16, 1·03, according to evidence given on the trial. But, taking into consideration some modifying circumstances, which would have occupied too much time in a court of justice, the floods of 1839, 1841 and 1843 are to each other as 1·04, 1·14, 1·00. In 1839 the dam on Cross river gave way during the freshet, the

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(2.) To prove this, take Hoghill brook, one of those emitted in the calculation. This stream has risen 4 feet on an overfall of 32 feet = about 1,400 c. feet per second, sufficient to raise the 400 acres of the Croton lake 3·5 inches in one hour; but, during that hour, the discharge over 85 feet, with a depth of 3·5 inches, would not lower the lake one-forth of an inch. Hence, several hours would elapse before the minor streams would raise the lake high enough to make their escape over the Croton dam as fast as they come in above. But it is proverbial on the Croton, that, when the small streams fall, the large ones begin to rise, and in the natural state of the river the former would be in or pretty near the Hudson, only 8 miles distant, instead of being, as now, pent up in the Croton lake until the main tributaries come down and pour their floods over the Croton dam simultaneously with the waters of the minor streams. Again, although in the freshet of 1843 the tributaries fell more rapidly than ever before observed, the water on the Croton dam rose to and receded from its maximum very slowly, obviously on account of the equalizing power of the Croton lake.

subsequent rise was not taken into account in the evidence, by which omission the flood of 1839 appeared less than that of 1843.

Again, it was proved that the flood of 1837 rose from 15 to 18 inches above the brick floor of Bailey's rolling mill, and, 2 or 3 square feet of this being fortunately left, the writer took the level of this fragment of the wreck, and found it 20 inches below extreme high water mark of 1843. The resident engineer testified that the flood of 1839 was only 7 inches higher than that of 1837, so that the freshets of 1839 and 1843 were shown to be nearly equal by two independent measurements: 1, by measurement of the tributaries; 2, by their near equality with the flood of 1837, and consequently with each other. Lastly, it has been stated, that half an hour before the dam gave way, the water at Bailey's dam was 6 inches lower than in 1839—it was further proved by all witnesses living on the Croton, at or near the site of the dam, that the flood of 1839 rather exceeded that of 1841, by observations taken as soon as the "lake" had run out and the river had resumed its natural appearance.(3) So that in fact, the defendants were indebted to the writer—the plaintiff's engineer—for the only plausible reason that the flood of 1841 might have slightly exceeded that of 1839. An examination into the peculiarities of the floods of 1839, 1841 and 1843 will satisfactorily explain all. In 1839 the freshet was general, all the streams being high—in 1841, the Muscoot and the two branches of the Croton were very high—in 1843, the minor streams and the Cross river were higher than ever since the great July flood, 46 years ago. Now, the east and west branches having their sources at a great distance, and draining a greater area than all the other streams together, do not discharge their floods into the lake till some hours after these latter have been falling, which they do with great rapidity. Hence the entire Croton may have been higher at the point of observation, two miles above the dam, in 1839 than in 1841, though the total discharge into the Hudson may have been much greater in 1841 than 1839. It is the highest rise during the flood which is alone important in this investigation.

Another view may be taken of the requisite waterway to pass any floods which can be expected. The writer was examining the streams of the Croton for the third time in March last, and from personal observation of the storm, has no hesitation in stating, that, considering the rain only lasted 12 hours, that the snow was nearly all in drifts and a large portion of it left, that 12 hours after the rain ceased, the wind chopped round to north-west, causing the tributaries to fall more rapidly than ever before known, and actually preventing the two main branches from reaching their ordinary flood mark—combining all these circumstances, he can only view the flood of 1843 as an ordinary high freshet, such as has occurred four times during the last seven years. Had the rain lasted two hours longer, and had the weather

(3.) It is well known that the Croton attains its maximum about 12 hours after the rain ceases, which would give the highest water on the 8th January, 1841, about 10 or 11 A. M., when it was proved, beyond all doubt, that it did not quite equal the flood of 1839, at a point two miles above the dam, and below all the main tributaries.

cleared off warm, the flood of 1843 must have stood 6 feet on the very edge of the fall and between 7 and 8 feet at the upper end of the culvert house. Had the snow of 1836 gone off as rapidly as in 1839, the flood must have been almost twice as great as that of 1843. Such occurrences are anything but impossible, and common prudence would lead us to anticipate them. Yet every engineer will see that the floods of 1837, 1839 and 1843 were far more than sufficient to have swept away the old dam, and if we allow one half for any flood which can be expected, we shall have a waterway of about 400 feet, supposing the water in the pond not to rise more than 6 feet above the lip. To withstand this column of water will require much more substantial work than is, or rather was, to be found at the foot of either the old or the new dam.

The water commissioners say in the first part of their report, 11th January, 1841, (Doc. 39, p. 513,)—"The width of the sheet of water flowing over the dam is 90 feet, and it is supposed in time of a freshet, will be from 4 to 6 feet deep; it has already, in the last autumn, been equal to 3 feet."

In the same report, after the news of the flood had reached them, they say: (p. 534,) "We have stated above, that the calculation was, that the water might rise from 4 to 6 feet above the overfall dam, but instead of this, it rose to about 15, and for this rise the dam was not calculated; the earthen embankment gave no protection against such a height of water; and the overfall was not of a capacity, although 90 feet in length, to discharge the water which the flood brought down. * * It is obvious that greater provision must be made to allow this stream to pass, in its natural channel, in time of freshets."

Here it will be seen that nearly two years after the flood of 1839, the commissioners—of course by authority of their engineers—state that the Croton will rise from 4 to 6 feet on their dam, when the Muscoot alone in 1839 rose 4 feet on a lip of 82 feet; the Titicus 4½ feet on 73, and the two branches of Croton united, above 6 feet on 100. In March last the Cross river rose 5 feet on 107 feet, which, taking into account the greater velocity of approach, is more than the entire Croton was ever to discharge, according to the views of the commissioners and their engineers.

The defendants asserted, that the flood of 1841 was not only greater than any previous known flood, but so much greater that it could not possibly have been foreseen. That they had a waterway capable of passing 50 per ct. more water than passed in the flood of 1839. The choice lay between exaggerating the flood of 1841 or underrating that of 1839. The latter course was adopted, thus: the freshet of 1839 occurring during the construction of the dam filled an area of 1028 square feet, including its own additions to the prepared waterway; the flood of 1843 filled an area of 1472 feet at Tompkins' bridge one-fourth mile below, and, *assuming* the velocities to be equal, the flood of 1839 would rise 7 feet 4 inches on a lip of 85 feet, the flood of 1843 would rise 10·64 for 85 feet—the depth being in both

cases taken at the edge of the fall. The flood of 1841 was taken as equal to 13 feet on 85, though nothing can be more uncertain than its depth *on* the lip for some time before the dam gave way. It will be observed that the flood of 1843 was necessary to the assumption, the whole statement having been prepared for the trial.

Another calculation, the surveys for which were made a few weeks before the trial, was presented, based on the *assumption* that the rise in floods was proportional to the area drained—contour of ground, clearing of land, and aspect going for nothing—and that all the tributaries were equally affected by the same flood. Unfortunately for this latter theory, the lower tributaries, draining one-third less land, discharged in 1843 one-third more water than the upper tributaries, owing to local causes, and sudden change of weather.

But the most extraordinary circumstance of this defence was that no measurement whatever of the absolute quantity of water passing in freshets was taken previous to, or during the construction of the dam. The area of the flood of 1839 was known, but the velocity was not taken. Now there was Bailey's dam within half an hour's walk of the Croton dam, over which had passed the floods of 1837 and 1839, and where proof of the most overwhelming kind would have been furnished any day, that ordinary prudence required a waterway quite as large as that of the new dam—250 feet. It did not appear that any marks had been established, or anything whatever done to determine the maximum flow of the Croton, before the completion of the dam. The freshet of 1843 ran over the floor of the bridge below the new dam, so that even up to 1843 the flow of the Croton in high floods was an enigma to the chief engineer, who, it appeared on the trial, had paid peculiar attention to the work.

In judging of the construction of the dam, it must be borne in mind that the engineer had "carte blanche" as to location, plan, dimensions, material, and —last though not least—time, to say nothing of competent assistants—in short every advantage which could possibly be desired. Justice to him requires us to consider this as his "beau ideal" of a permanent dam, for the most important of all purposes for which any structure can be designed, in which his principal assistant coincided, testifying that he considered it to be a structure of "unexampled strength." The resident engineer gave no opinion on the subject.

The writer's objections were: that the approach was bad, that the entrance should be somewhat in the style of that of a lock or culvert, instead of converging up stream, that the angular wingwall presented the junction of earth and vertical masonry to the current, instead of being carried around 40 feet into the solid bank, thus aiding the discharge as well as increasing the stability; that the greater part of this wingwall rested on a crib of concrete, and on account of unequal settling, was carried up without any bond, "rich grout" being poured into the seam whenever any settling took place, and that

a very small opening of this joint would render the loss of the dam inevitable. That the loss of the apron endangered the dam by causing the undermining of the protection wall at its junction with the apron and masonry, which would be followed by the sand of the embankment till the latter became too weak to stand against the pressure from above.

Mr. Clowes, an experienced engineer, objected to the embankment "in toto," that a wall of hydraulic masonry should have been carried across the valley; that the dam should have been arranged with flash-boards for summer, so as to keep the permanent lip as low as possible, every foot in height being an object with such a mass of water; that, over a smaller river than the Croton, he had, from prudential considerations—the result of 30 years observation—built a dam with a tumble or lip of 400 feet with less than one-third the fall of the Croton dam; that it was injudicious to make the reservoir *in* the river, when there were so many opportunities of making more secure ones in vallies crossed between Sing Sing and the Harlem river.

It was urged on the defence that, though the entrance was narrower it was much deeper than at the lip, and gave a much greater section, hence the width was unimportant; in other words, it might have been worse had the depth as well as the breadth been reduced. The wingwall was not to add any strength to the dam, but merely to keep the embankment from filling the culvert, 17 feet below the lip, hence a slight opening of the seam—even if it did take place—would be harmless. That to carry the wingwall 40 feet into the bank would be an unheard of precaution, and that the pressure of the earth against the masonry with one or two little projections running 8 or 10 feet into the embankment was abundantly sufficient. The only remark bearing on the apron was, that it was admitted to be quite inadequate to withstand the action of 10 feet ([4]) water on the lip, though an efficient waterway of 12 feet had been previously claimed by the very same engineers —the only engineers giving evidence on the part of the defendants. Mr. Clowes had objected also to the quality of the earth forming the embankment —principally sand—with a tendency to quicksand; the engineers of the city considering it a good material for the purpose, being composed of sand, gravel and loam. The writer observed also that the thickness of the banks of the enlarged part of the Erie canal was 7 times the depth, about the same proportion as obtained here, *except* at the wingwall, where the embankment offered the least resistance though the pressure was the greatest.

Numerous other subjects came up, as the value of the cribwork in the embankment, the almost universality of the custom of making the lip much wider than the stream in its natural state in place of as here, narrower, but

(4.) The apron of the new dam was torn out by the freshet of March last, though the face of the waterway is curved so that the water leaves the foot of the masonry in a horizontal direction. Still the apron of crib work—unquestionably superior to that of the old dam—gave way the first flood with four and a half feet water on the lip; the water excavated a large hole at the foot of the masonry and it will require great exertions, a large expenditure, and good luck, as regards weather, to render the dam reasonably secure against a great flood next spring. Its fate, with a great summer flood—such as has been known in the Croton— would be scarcely doubtful, and, viewed even in the most favorable light, the condition of the dam is, at this moment, most unsatisfactory.

above all, the propriety of carrying a vertical stratum impervious to water entirely across the valley, as for instance a wall of masonry founded on solid rock or secured by two or three rows of well-jointed piling, etc., in short, that at least all the precautions taken on works of far less importance should have been found here.

Appearances after the flood were described to have been as follows: embankment and protection wall gone, masonry of dam proper, generally uninjured, except a few of the lower courses of the face of the dam which were carried away. The first course was stepped into the solid rock, and this being unable to withstand the action of the water, the masonry of course followed and many pieces were carried far down the river. The wingwall from the joint northward was gone, also the crib of concrete —one piece, more than 20 tons in weight, having been carried several hundred feet down the river—also a large crib sunk across the natural channel, near the head of the masonry, used as a cofferdam during the construction of the work. The filling of the old channel was taken out down to, or below the original bed and the foundations of the remaining masonry, where not of solid rock, were torn from under, so that a bar could be in some places run from 4 to 6 feet under the abutment wall. Yet 60 feet north of the masonry, and on the same level, the sand and gravel remained undisturbed, showing an almost irresistible force acting along the base of the abutment, yet confined to so narrow a space as to have been harmless at the trifling distance of 50 or 60 feet north of it. Apron entirely gone and 20 feet of water in its place.

This description agreed well with the appearance of the dam in July, 1841, when visited by the writer. The water was then very low and the powerful action of the flood near the foot of the masonry was so clearly indicated, that he had no hesitation in concluding, that such effects could have been produced by undermining only.

The destruction of the dam on the 8th was considered a matter of course in that part of the country, and would have been honored with a large audience had it taken place by daylight. As it was, it was seen only by those at work on the embankment, and by one man on the south side of the river. The former, witnesses for the defendants, were one of the contractors, (Crandall,) a superintendant of masonry, (Adamson,) and a laborer. They testified that the water forced it way between the frozen and soft earth, that it broke out about 100 feet north of the masonry, and about 8 feet below the top of the embankment, running over the protection wall and widening to a channel of 150 feet, but leaving about 40 feet of the embankment and protection wall standing next the masonry; that this continued for about an hour, at the end of which time the water was still running over the lip of the dam proper. The witness for the plaintiff, (Green,) a very intelligent mechanic, who stood on the south bank, swore, that just before the dam gave way he observed a whirlpool immediately above the wingwall, suddenly the

water receded from the bank and burst through the foot of the embankment at the masonry, the protection wall above, falling, as it were, up stream. The hill on which he stood trembled with the shock, and the noise was heard for miles in all directions.

A son of one of the contractors, (Brayton,) on the part of the plaintiff, testified that two hours before the dam gave way, the earth behind the wing-wall was very soft, that water was to be seen on the lower side of the wall in violent agitation, that the men on the dam were trying to fill the hole up, and that a load of earth was dumped in. This was admitted by Crandall, who ascribed the softness of the earth to the rain.

It will be observed that Green swore that the embankment next the masonry went first—Crandall and Adamson that, an hour after the water broke through, it was the only portion left. There is no reconciling these statements. Whether it be physically possible that an embankment of sand, supported by a dry wall, should stand as a dam 40 feet high, for one hour with 8 to 10 feet of water rushing over it and that this same mass of water, aided by 400 acres of ice, should fall during that time from that height without disturbing the sand and gravel on which it fell, are questions to which but one answer can be given. But, independently of this, it was contended that the appearances near the dam—the rapid falling of the lake two miles above the dam, 6 or 8 feet in 1 or 2 minutes—the noise distinctly heard 6 miles off---the marks of the ice on trees 30 feet above the level of the river---the rise of more than 20 feet at Bailey's wire works, though the valley is a quarter of a mile wide and two miles below the dam, sweeping away houses, barns, mills and even heavy rolling machinery in its mad career, showed conclusively that the dam gave way at once, instead of being gradually washed down.

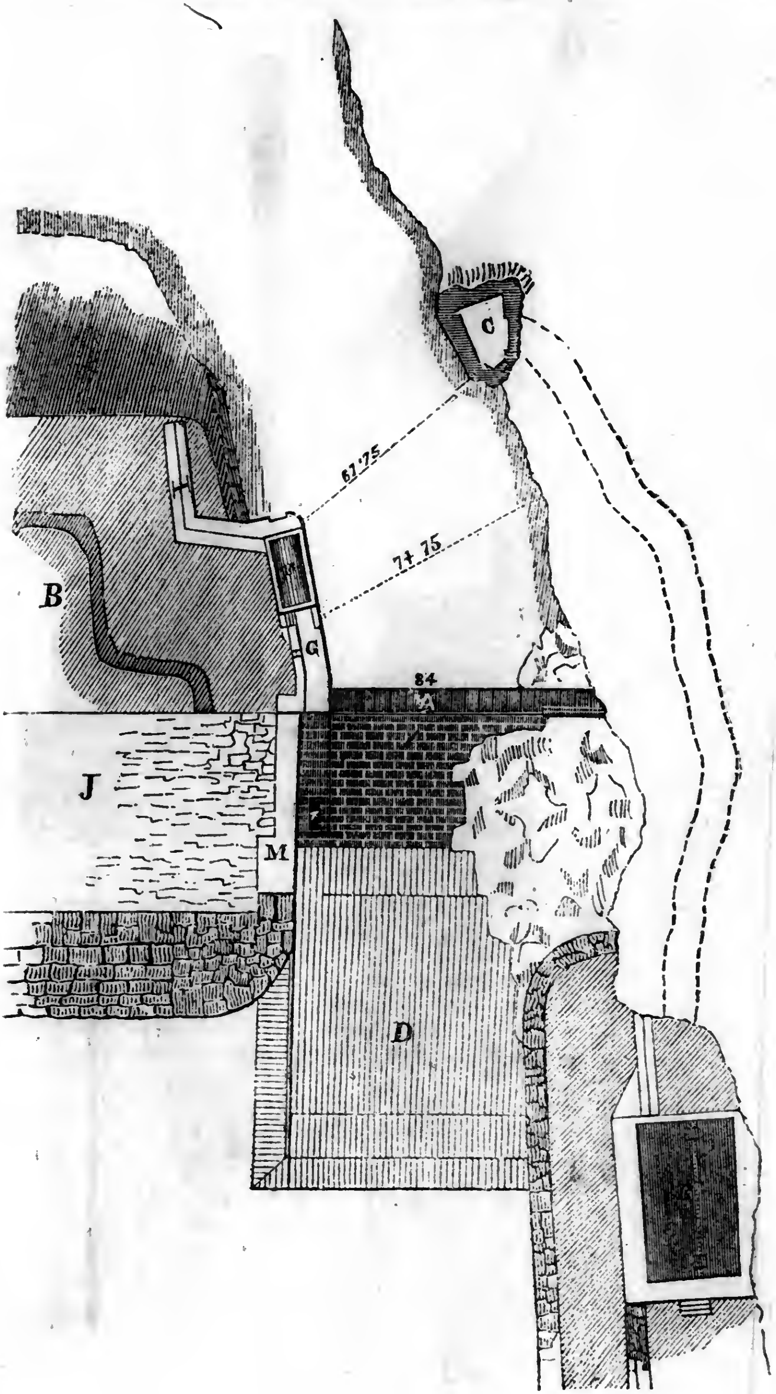
The grand argument on the part of the defence was, however, the high standing of Mr. John B. Jervis, an engineer at the head of his profession in this country, the greatest country for public works, in short the "greatest practical engineer" of the age, just about to retire on his laurels, which would be withered by a verdict for the plaintiffs. Still *if* they believed negligence to be proved, they must find for the plaintiffs, "*and let the country bleed.*"

The cool, contemptuous style of the following remarks of the commissioners---one of them an engineer of high standing and great experience---says more than the most violent invective could do; the common sense view in the last passage, as obvious as it is irresistible, would of itself have justified the verdict rendered for the plaintiffs. (The italics are the writer's.)

Doc. 17, Report of the Water Commissioners, 12th July, 1841, p. 87. "The construction of the dam *now* building, will, according to the estimates, amount to about one hundred and twenty-seven thousand dollars; but it must be recollected that *this* dam will be a *mason work* dam, laid in hydraulic cement, in the place of the *mere* earthen filling in, with a *dry* protection wall laid with *rough* stone, so that the dam when *now* finished will be an *entirely* different structure from *that* part of the dam carried away, and will *correspond* in strength and durability with the *rest* of the work, certainly much more so than the dam as *formerly* constructed; *and as the dam creates the supply, the importance of its strength and durability, in the original construction, is very obvious.*"

New York, July, 1843.

Note. Of the numerous works on hydraulics consulted by the writer, no one gave so good a view of this branch of the science as Mr. Roebling's essay, published in this Journal, December, 1838.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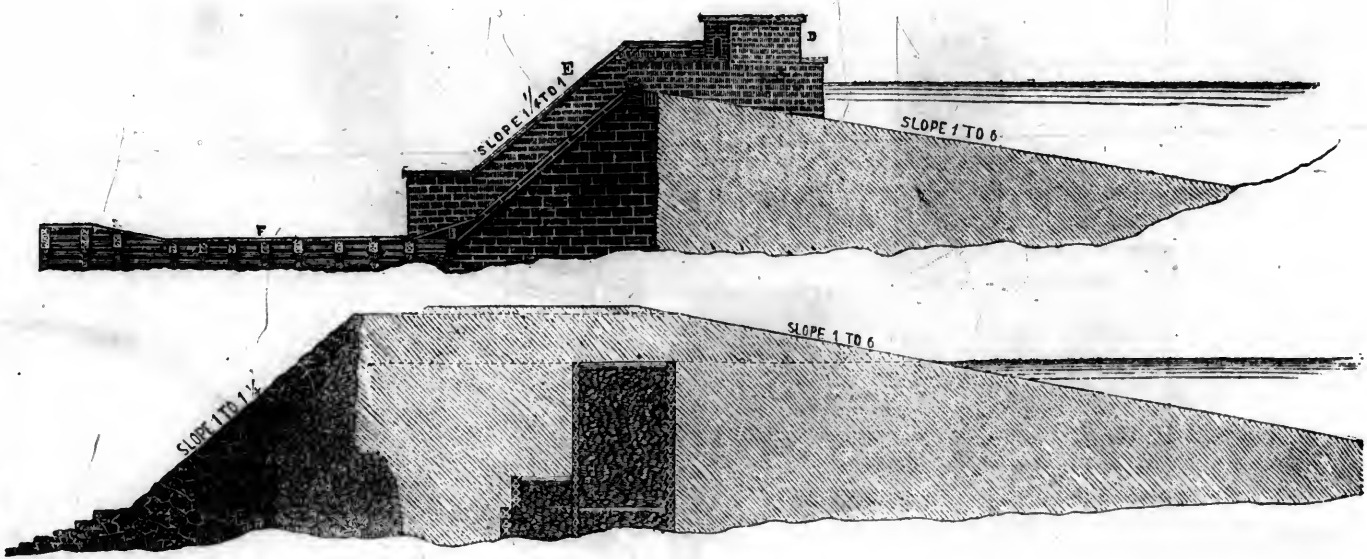

REFERENCES TO PLAN.

A, Lip,
B, Embankment,
C, Mouth of tunnel,
D, Apron,
E, Gate house,
F, Culvert house,
G, Abutment platform,
H, Abutment parapet,
I, Wing wall,
J, Protection wall,
K, Culvert.

REFERENCE TO SECTIONS.

D, Culvert house,
E, Abutment,
F, Apron,

Scale 60 feet, to 1 inch. Embankment 250 feet long.

RAILROADS IN GERMANY.

The year's result of the German railroads at present in activity has been published, and shows an increase of nearly two millions of travellers in 1842 as compared with 1841. The following table will show the number of passengers and the amount, (in English money,) received for passengers and goods during the month of December, and during the whole of the year 1842.

Names of Railroads.	During December, 1842.		During the whole of 1842.	
	Number of passengers.	Money received.	Number of passengers.	Money received.
Linz-Budweis,	None.	£1,566	14,274	£23,992
Linz-Gmunden,	5,556	1,258	121,155	20,055
Leipzig-Altenburg,	8,173	1,072	43,622	5,266
Munich-Augsburg,	9,229	1,563	213,647	26,865
Hamburg Bergedorf,	9,315	242	153,648	5,277
Berlin-Stettin,	12,135		70,880	
Berlin-Frankfort,	13,278	2,186	35,274	7,385
Breslau-Oppeln,	14,236	932	139,099	8,633
Manheim-Heidelberg,	16,506	522	307,692	9,696
Cologne-Aix la Chapelle,	17,760	2,439	317,776	39,914
Dusseldorf-Elberfeld,	19,113	1,153	384,946	
Brunswick-Harzburg,	20,700	2,329	289,454	14,893
Berlin-Anhalt,	20,925	5,873	318,659	79,577
Vienna-Stockerau,	20,826	1,076	321,490	14,894
Vienna-Brunn-Olmutz,	21,638	9,416	297,505	110,617
Magdeburg-Leipzig,*				
Leipzig-Dresden,	24,932	7,465	377,380	98,579
Berlin-Potsdam,	30,505	1,565	500,906	23,692
Mentz-Frankfort,	32,811	1,487	809,012	37,795
Nuremburg-Furth,	33,874	402	450,635	5,271
Vienna-Raab,	36,535	3,795	1,151,393	71,641

The total number of passengers during the month of December, (without including Magdeburg and Leipzig,) was 368,049; the number in the corresponding month of 1841, was 289,864. During the whole year of 1842, the number of passengers was 6,829,002, whereas in 1841, the number was 5,071,342; so that, on the whole year, there appears an increase of 1,757,660. In the returns of several of the lines the amount received is not specified, owing to their not having made up their accounts for the last quarter at the time the general statement was made up. Approximate calculations have in the mean time been made, according to which the whole number of travellers, along all the lines, has been estimated at 6,870,000, and the amount received 7,000,000 Rhenish florins, or about £583,333; a sum perhaps less than was anticipated by the original estimates of the different companies, but which must still be looked on as large, when the circumstance is taken into account that the majority of the twenty-one railroads enumerated in the above table are still incomplete, or are only portions of a more extensive system, the real traffic of which will not be known until the whole system has been brought into activity. Even those lines which are complete, such as the lines that connect Berlin and Dresden, or Vienna and Olmutz, will probably become much more productive to their proprietors when the other lines now in construction shall have covered all Germany with a net of railroads.

The Linz Budweis railroad conveys no passengers during the winter months, owing to the accumulation of snow in the mountains, and the con-

* Had made no return at the end of January.

sequent impossibility of making the trips with any degree of regularity. Indeed, upon all the German railroads, it will be seen the number of travellers was small in December, compared to the monthly average of the year.

The Leipzig-Altenburg line is only the commencement of one which is to connect the chief cities of Saxony with those of Bavaria. The road was partially opened to Altenburg on the 19th of September, and will in a few months be further opened to Crimmitzschau. The Bavarian government seems determined that that part of the railroad which will traverse Bavarian ground shall be constructed with the least possible delay. The railroad is to enter the Bavarian territory at Hof, whence it is to pass through Augsburg and Nuremberg, and run on to the southern frontier at Lindau; thus traversing the entire kingdom from north to south, a distance of about one hundred and fifty leagues. The bill for the construction of this railroad has been submitted to the Bavarian Chambers. The expenses of the construction are to be covered by a loan.

The Munich-Augsburg company have declared a dividend for the year, on their shares, of three per cent. We have not heard whether the shareholders have made up their differences with the directors, or whether the company can yet be said to have lost the unenviable distinction of being the worst managed of all the German railroads.

The line, however, which at the present moment justly excites the greatest interest in Germany, and which to England is of more importance than all the other German railroads put together, is the projected line from Hamburg to Berlin, of which as yet only a few miles have been completed, viz., from Hamburg to Bergedorf. The enterprizing mercantile community of Hamburg were, if we mistake not, the first in Germany to bestir themselves for the establishment of railroads, but encountered so many obstacles in the jealousy of their neighbors, that one plan after another was abandoned in dispair. It was at length, however, determined that so much of the line towards Berlin as ran upon their own territory should be executed at all events, and they calculated that when a commencement had been made, they would find it all the easier to overcome *personal* objections. All opposition on the part of Denmark and Mecklenburg has gradually been overcome, the political difficulties to the undertaking have been all obviated, and nothing now remains but to raise the necessary capital in order to proceed with the construction of the railroad.

In ordinary times there would be no difficulty in obtaining, in Hamburg and Berlin, purchasers for all the shares in such an undertaking as a railroad intended to connect the two cities; but at the present time several circumstances contribute to impede the prompt filling up of the subscription list. The calamity which befel Hamburg last May is still severely felt there, independently of which Hamburg has largely participated in the effects of that commercial depression under which England has now been suffering for so considerable a time. Many of the citizens of Hamburg have passed from affluence to poverty in consequence of the great fire, and many more are probably still struggling to conceal from the world the state of insolvency to which that calamity has reduced them. Capital is, therefore, necessarily less abundant in Hamburg now than in more prosperous times, and other circumstances contribute just now in Germany to invite the investment of surplus capital in other undertakings. The king of Prussia has projected a colossal system of railroads to radiate from his capital towards the extreme points of his kingdom. Many of the lines which he has determined on, and which have received the sanction of the States, however important they may be in a political or military point of view are not likely to produce much

profit to those who would make them at their own risk; the king, in order, nevertheless, to insure their construction, has guarantied to the capitalists who will undertake them a minimum interest of three and a half per cent. This guaranty fund is not to be extended to the line from Berlin to Hamburg, which has been looked on by the Prussian government as so secure a speculation that no guaranty from the State would be requisite to induce capitalists to enter upon it. Eventually this anticipation will no doubt be fully justified; but in the mean time, what may be called the State railroads in Prussia, will by many be deemed a safer investment, the Prussian government guarantying the dividends on the shares, not merely from the time when the railroads shall have been completed, but from the day when the works commence.

In addition to these circumstances, there are certain local jealousies and rivalries that are exerting such means as they have at their command to delay, if they cannot wholly prevent, the construction of the railroad between Hamburg and Berlin. When the lines now in construction are completed, there will be two great lines extending, the one from Trieste, over Vienna, Prague and Dresden, to Antwerp; and the other from Trieste, over Vienna, Breslau and Berlin, to Hamburg. Should the line to Antwerp be finished sooner than that to Hamburg, there can scarcely be a doubt that the Antwerp line would become the main artery for German commerce, and that much of the trade of Hamburg would be drawn off by her Belgian rival. It may be worth while to present the present state of these two lines to our readers in a tabular form.

	Ready.	In construction.
From Trieste to Gloggnitz,		50 miles.
From Gloggnitz to Olmutz,	40 miles	
From Olmutz to Prague,		32 miles.
From Prague to Dresden,		20 miles.
From Dresden to Magdeburg,	30 miles	
From Magdeburg to Hanover,	20 miles	Not yet opened, but certain to be opened in a few months.
From Hanover to Cologne,		48 miles.
From Cologne to Antwerp, (or Ostend,)	40 miles.	
	130 miles.	150 miles.

Of the line from Trieste to Antwerp, therefore, 130 (German) miles of railroad are complete, and 150 miles remain to be executed; but of the construction of these 150 miles, within a brief space of time, there can scarcely be a doubt, now that the Austrian and Spanish governments have taken the respective lines under their powerful protection. Whether these governments are acting wisely, in burdening themselves with a guaranty which must have the effect of adding to the national debt of either country, time alone can solve.

The following is the present state of the line from Trieste, over Vienna, and Berlin, to Hamburg:

	Ready.	In construction.
From Trieste to Gloggnitz,		50 miles.
From Gloggnitz to Leipnick,	40 miles	
From Leipnick to Oppeln,		20 miles.
From Oppeln to Breslau,	10 miles	
From Breslau to Frankfort-on-the-Oder,		34 miles.
From Frankfort to Berlin,	10 miles	
From Berlin to Hamburg,		36 miles.
	60 miles	140 miles.

On the former of these lines, it will be seen, a much larger portion of the work has been completed, a larger amount of capital has consequently been invested, and a powerful rival interest is organized, which will do what it can to deter the timid from investing their funds in a railroad from Berlin to Hamburg. Bohemia, Saxony, Hanover, the Prussian provinces on the Rhine, and Belgium are interested, or believe themselves to be interested, in defeating the Hamburgers, and the consequence has been an active paper warfare, which has of late been extended even to England. Calculations are constantly published in the newspapers with a view to demonstrate the improbability of a remunerating traffic, and a friendly uneasiness is even expressed lest some unfortunate dupes should be prevailed upon in England to throw away their money on so hopeless an undertaking. An instance of this occurred in our own paper, on the 8th instant, when *an advertisement* of some length was inserted in the shape of a letter, purporting to proceed from an Englishman at Berlin, who was made to give expression to sundry apprehensions lest the purses of his confiding countrymen should be laid under contribution. We have no objection to warnings of this sort. John Bull has, in his time, been seduced to invest a deal of his hard earned money in the purchase of moonshine, and it will be better for him in future to be too cautious than too confident; at the same time, well aware of the quarter whence these warnings proceed, and of the motives that dictate them, we are not inclined to attach much importance to them, or to feel any deep obligation to their authors.

There is no city on the continent in whose welfare England is more interested than Hamburg. Our exports to that city average annually from five to six millions, (nearly the whole being cotton and woollen manufactures and hardware,) and every additional facility of communication with the interior must have the effect of increasing so profitable a trade. The railroads, terminating at Antwerp, run, moreover, through no part of Germany, but the States embodied in the Customs Union; whereas, nearly half the line from Hamburg to Berlin passes through Danish and Mecklenburg territory, where the duties on British manufactures are comparatively trifling, and are likely to remain so, neither of these two countries having any manufacturing interests to protect, and both of them being deeply interested in cultivating a commercial intercourse with England for the disposal of their agricultural produce. The moment either line is complete to Trieste, that line must become the road from England to India, in preference to that over Paris and Marseilles; but there are many reasons why the line from Hamburg over Berlin, about 900 English miles in length, would be preferable to that from Antwerp, over Dresden and Prague, which would be at least 1,260 English miles long.

The people of Hanover look to England for some assistance in carrying out their railroad, in the realization of which they think England almost as much interested as themselves. Individual capitalists, however, will be guided by the prospects of profit only; and of all the continental railroads we know of none that promises better. At the termini of the line we have a population amounting to more than half a million of souls; and although no large city occurs on the way, yet at both extremes the railroad will come into communication with an intercourse of wide extension and first rate importance. The country, moreover, through which the railroad will run is nearly a dead level, and it may be doubted whether there is any railroad of the same length, in any part of the world, in the construction of which fewer natural difficulties have presented themselves, than may be looked for between Hamburg and Berlin. All the railroads terminating at Berlin,

and now in activity, have turned out profitable undertakings, and of all, the shares are now at a considerable premium.

The companies interested in the steam navigation from Hamburg to Magdeburg are also active in their exertions to prevent the realization of the railroad from Hamburg to Berlin, though it may be doubted whether the river traffic, particularly with the steamers, would not continue with nearly the present activity, even if the railroad were in full operation. The travelers to Saxony, Bohemia and Central Germany would still continue to journey up the Elbe to Magdeburg.

The Leipzig-Dresden line has published its annual report, and a very satisfactory report it is for the shareholders. The dividend for the last year is to be 6 per cent., and the estimates for the coming year promise a considerable increase in the receipts, accompanied by a considerable reduction of expenditure. The receipts of 1842 showed an increase of 50 per cent., as compared with those of 1841. Till recently this railroad had been working with a single line of rails. The second line is now completed, and will allow a greatly increased activity. Branch lines are spoken of from Leipzig to Chemnitz, and from Dresden to Chemnitz, as likely to be undertaken in the course of the present year.

No German government is exerting itself more zealously in the cause of railroads at present than that of Austria. The report of the Vienna-Raab company for the last year appears to have been quite an agreeable surprise to the shareholders, who, if we understand aright the abstract that has appeared in a German paper, have received five per cent. interest on their capital, independently of a half per cent. which had been paid over to the reserved fund. The works of the government, however, will in a short time give increased value to this line. The works for the extension of the line to Trieste are in active progress, and so, at the other extremity, are those for the extension of the Vienna-Olmutz railroad to Prague. A treaty has been concluded with the Saxon government for the railroad from Prague to Dresden; so far, therefore, as Austria is concerned, the railroad from the Adriatic to the North sea has been provided for. Even during the winter, from five to eight thousand workmen have been constantly at work on the Bohemian part of the line, but on the return of spring it is intended to strain every nerve to accelerate the great undertaking.

A new German railroad, that between Heidelberg and Carlsruhe, will shortly be opened as far as from Heidelberg to Langenbrucken, a distance of about fifteen miles. Experimental trips were performed on the 26th and 27th ultimo, but we have not yet seen any account of the railroad having been opened for the use of the public.

In the kingdom of Wurtemburg, also, the government has very splendid schemes, which will probably be realized, but not without imposing a considerable additional debt on the country, in the shape of a guaranty fund to the capitalists who advance their money. There are to be private railroads and State railroads in Wurtemburg; the former are to be undertaken by companies, to whom the government guaranties an interest of four per cent. on the capital advanced, reserving to itself, however, the right of buying up the railroad on payment of the money expended on them. The State railroads are to be constructed by the government, and a loan is to be raised to defray the expenditure. Among the lines recommended by the committee of the second chamber is one to connect the Rhine and the Danube, from which several branches are intended to radiate

In looking at the immense works now in progress in Germany, it is impossible to forbear from speculating upon the vast results that must in a few

years be obtained. With a railroad 900 miles in length it will be quite practicable to travel from Hamburg to Trieste in forty or fifty hours, and thus a saving of several days will be effected in the transit of the overland mail from India to England. The whole system of continental travelling, moreover, must undergo a change; for it will be intolerably absurd to make a man waste days at a railroad station on the formalities of his passport, when in the space of time thus lost he might have travelled from the North Sea to the Adriatic. Will not even the national character be likely to undergo a modification when such rapidity of locomotion has become one of the accustomed occurrences of life in every part of the country?—*London Chron.*

It may not be known to some of our readers, that at the late session of the legislature, an attempt was made to procure a charter for a railroad from New York to Albany and Troy, to be located immediately upon the eastern bank of the Hudson river. This, of course, would have been a rival line to that of the New York and Albany railroad, and in endeavoring to forward their application, the advocates of the "river line" have not hesitated to make the most absurd statements in comparing the two routes. The report from the committee to whom the matter was referred, very properly put the project to sleep—and in doing so, has not spared the absurdities and inconsistencies of the petitioners. Among other things, they quote the very words of a former report of the engineer who now advocates the river route, in which he took ground diametrically opposite to that which he now takes.

In answer to some of the, so called, arguments brought forward, Mr. E. F. Johnson, chief engineer of the New York and Albany railroad company, prepared a statement, which was presented to the legislature. As this paper of Mr. Johnson's touches in one place upon a point of professional interest, we have selected a few paragraphs for publication.

"The river line is also represented to have a maximum grade or inclination of thirteen feet less per mile. Assuming this statement to be correct, it does not by any means follow that any very material advantage is derived therefrom to the river line, either in the average velocity of movement or in the cost of transportation.

Both routes have their termini upon the *same level.* If, therefore, there is more ascent upon one line, it must also have an equal surplus of descent, so that the aid afforded by gravity in the latter case will be precisely equal to the resistance in the former.

For the purpose of illustration, let it be supposed that the rate of ascent on the two lines, for a given distance, to be equal to the maximum on both, namely, thirty feet per mile on the one, and seventeen feet per mile on the other. If with a given power a given load is conveyed up the latter at the rate assumed, of twenty-six miles per hour, the same power will convey the same load up the former at the rate of twenty-three miles per hour, nearly, (see the New York Assembly Documents, No. 133, page 11, 1839,) making a difference in the speed on the ascent of three miles per hour. If these grades occupy half the whole distance, and the journey between the two extremes is performed in six hours, the train which is on the lowest grade will commence its descent about nine miles only in advance of the other, or twenty minutes sooner in time. To make up for this loss of time, on the remaining half of the distance, the train on the thirty feet grade has the bene-

fit, in its descent, of the greater force of gravity on that slope, compared with the slope of seventeen feet per mile; and hence the whole distance will be accomplished with the same expenditure of power in the the same, or very nearly the same time.

If the rate or degree of inclination of the grade line was so great in any part as to render it impossible, from considerations of safety, to derive the full benefit of the aid afforded by gravity on the descending portion, the result would be different and a disadvantage might ensue; but such is not the case where the maximum inclination does not exceed the limit of thirty feet per mile, the average much below that amount.

Admitting it, however, to be possible that some little difference may exist in favor of the lower grade on the river line, yet it cannot be denied that the interest upon the superior cost of that line, amounting probably to not less than **$50,000** per annum, will manifold more than cover the difference in the expense of fuel, or whatever extra power of traction is needful to convey the same load with the same average speed over the interior route.

So far, therefore, as it regards the *through* trade and travel, the interior route will be found to be quite as efficient as the other. This conclusion is in accordance with the experience on all the railways in operation of a similar character, having grades not exceeding thirty feet per mile.

I am aware that the opinion has been advanced that a difference in the elevation of a summit of from seventeen to twenty-five feet per mile is equal, when *equated*, to one mile of horizontal distance.

For very high grades and high summits this rule, *arbitrarily assumed*, might not be widely at variance with the truth; but where the grades range below the limit of thirty feet per mile, and the average, as is the case on the interior route between New York and Albany, does not exceed more than half that amount, the rule is not in the least degree applicable.

With respect to the *way* business, which, if we may judge form the experience upon the New York and Erie and other roads, must constitute a considerable portion of the whole business of the New York and Albany road, the superior elevation of the ground on the interior route will be found an advantage rather than otherwise. This is evident from the fact that the region of country which will furnish a surplus produce for market, is elevated considerably above the line of the road. The road is therefore more accessible from the surrounding country from having this elevation, and will be more likely to obtain in consequence its fair share of business in competition with the river.

There is another and still greater advantage to be derived. The most elevated portion of the interior route is situated, as already stated, near the north line of Dutchess county. From that point to New York city, the grade has an average descent of eight feet per mile for one hundred miles. Nearly all the way freight, forming possibly the greater portion of the freight conveyed in summer, will come to the road in this distance, and as the average descent is in the direction of the preponderance in the trade, being towards the city, more will be gained than lost, in consequence, in the expense of transportation. * * * * *

As to the amount of way business to be furnished to the railroad, it must be remembered that the proposed river route can only draw to its support that which flows in from *one side*, which for eight or ten months in the year must be divided with the steamboats and other craft upon the river. * *

It should be borne in mind, in considering the relative merits of the two routes, that the river line will not serve to cheapen the transportation of produce to the city from the eastern river counties, neither does it in the least

accommodate the rich marble and iron region which lies in and near the valley through which the interior route passes. * * *

The interior route also passes through a region at present deprived of any convenient mode of communication with the city."

CHESAPEAKE AND OHIO CANAL.

At a general meeting of the stockholders at Frederick, on the 5th instant, we understand proposals were submitted by capitalists for completing the unfinished portion of the canal between dam No. 6, and the town of Cumberland, as also for the extension of the work to the mouth of Savage. But it will be seen by the annexed report, that the company deferred entering into any contract before affording a reasonable time for any other persons to offer proposals, and thereby release the directors from any censure that might possibly accrue to them, as well as to afford the authorities of the State an opportunity of carrying out the provisions of the legislative enactment with regard to the sale of the work. We think the proper course to be pursued is here marked out, and such an one as will meet the approbation of the friends of the canal.

As to the prospects of the work on the canal being commenced soon, we of course cannot speak positively. We learn that General M'Neill, the president of the company, is still very sanguine in his expectations—that he says the work *will go on soon*, and that, too, to *completion.* We sincerely hope he may succeed. We are indebted to our Baltimore correspondent for the following report:

REPORT.

The matter of the report divides itself into two distinct subjects:—

1st. The accounts, expenditures, sales of property, income from tolls, etc., or in general of the finances of the company. It has not been in the power of the committee to bestow upon these subjects the attention which their importance demands. We beg leave, therefore, respectfully to recommend that a committee of three be appointed by the chair to attend to this part of the president's report.

2d. Of the extension of the canal. We are of opinion that the interest of the State, and all interests connected with or to be developed by the canal, are eminently involved in the early and substantial extension of the canal, in conformity with its plan up to the town of Cumberland, and that to this end the energies of the president and board of directors should be directed with vigor and perseverance.

With this general expression of opinion the committee will bring to the consideration of the meeting the necessity of observing certain precautionary measures, which will now be indicated:

1st. That competition ought to be excited by public advertisement in the newspapers before contract be entered. Proposals to be received by the 26th June.

2d. No attempt should be made by the company to purchase State bonds until the treasurer shall have failed to effect a sale of the State's interest in the canal as authorized; say until the 10th July.

3d. That no contract shall be entered into except with the condition that it may be annulled by the company after thirty days' notice, at any time within twelve months after the date of said contract, on the payment of one per cent. as damages upon the unexpired portion of the contract.

4th. Provided, however, that nothing whatever shall be done by the president and board of directors which may prevent or embarrass the sale by the State of Maryland of her interest in the canal.

True copy of the report of the committee upon the report of the president and directors of the Chesapeake and Ohio canal company, submitted to the stockholders, etc., made June 6th, 1843.

Test. THOS. TURNER.

At the same meeting the following gentlemen were elected officers of the Chesapeake and Ohio canal company for the current year.

Gen. W. GIBBS MCNEILL, *President.*

Directors.

Col. Frisby Tilgham, John O. Wharton, Esq. } Washington county.
William Price, Esq., Allegheny county.
Col. James M. Coale, Frederick county.
Daniel Burkhart, Esq., Berkely county, Virginia.
J. P. Ingle, Esq., Washington city.

We have long since expressed our opinion that the Long Island railroad was destined to become one of the most important lines of improvement in the country. From the report now before us, we are pleased to learn that there is a fair prospect of an immediate completion of the work. The amount required for this purpose is but about half of the portion of the capital which yet remains to be called in. For the particulars in regard to cost of construction, etc., we refer to reports themselves.

We cannot but regret that the company have neglected contributing their share to the general fund of information, by not giving the details of expenses of conducting the road. It is true that the line is as yet incomplete, but this is no reason for the omission.

We have not included in our extracts that portion which refers to the prospective traffic of the road, as it was published in the last report. It does not, however, need much argument to convince even the general reader that a very liberal share of the travel east of New York will pass on this road. There is, however, one item which, from the results of our own observation, we feel convinced the directors have underrated—we refer to the local traffic both in freight and passengers. The company have based their calculations for this portion of income, upon the actual receipts for the road as at present in use. That this is far short of what it should be, we suppose the directors themselves do not doubt, and as any one may learn from the fact that several lines of stages do a good business along side of the railroad—in some cases even at a higher fare than that of the railroad. The mere question of undervaluing an item in the prospective business of the road, is of not great importance, and would, doubtless, at some future time, prove a very welcome discovery. But from the little attention this branch of their income has received from the directors, in their report, as well as from the system of management, we feel certain that an increase of attention to this point would result in an increase of profit. It is in vain to say that every exertion should be made to complete the work—this is all well enough—but is it a necessary consequence that the exertions to secure travel upon that portion of the work already completed, should not be made? This would indeed be a queer law,

and one that would forbid any care being bestowed on a road when finished. But a neglect of part of a work, is a neglect of the whole, in the moral, though not in the mathematical sense—and that which is productive of injury to the reputation of a part, is injurious to the whole road. With this view of the case we see far larger and more encouraging prospects than even the most sanguine hopes expressed in the report, would indicate. Upon Long Island alone, a traffic exists in part, and in part is yet to be created, that shall far exceed the most ample share of the eastern travel, ever likely to fall to the share of any one line of railroad or steamboat. Nor do we mean to doubt the estimates upon this point, there is no line of those in operation which can in any way offer the advantages belonging to this, and if nature had endeavored to form land for railroad uses, she could not have produced a better specimen than that traversed by the Long Island railroad.

LONG ISLAND RAILROAD.—REPORT OF DIRECTORS.

The capital of the company, as granted by their charter, is $1,500,000, in 30,000 shares, of $50 each. Of this amount, $28 25 per share has been paid by the stockholders, and the amount has been expended in the construction of the road, leaving $21 75 per share, or $653,500 still unpaid.

In giving a statement of the property and effects of the company, it will be proper to state that the road, as far as constructed, is of the permanent description, being laid with the heaviest solid rail of 56 lbs. to the yard, with a heavy superstructure laid the whole distance upon a deep gravel foundation.

The property of the company consists of 34 miles of road with the necessary appurtenances, consisting of turnouts, tables, car and engine houses, machine and blacksmith shops, store houses, dwelling houses, 12 in number, stables, offices, 20 lots of ground in Brooklyn, (Parmentier's garden,) and 50 lots in Jamaica, the Hempstead branch railroad of three miles, 4 locomotive engines, 15 passenger, and 30 burden cars, etc., the right of way for the construction of the road for a distance of nearly 30 miles, and the roadbed graded and prepared for the rails for a distance of 21 miles. The whole work and property having been obtained at a cost rising one million of dollars.

The debts and liabilities of the company are as follows, and payable at the periods stated, viz:

To the State of New York, payable in 1861,	$100,000 00
In a second mortgage on the road, being a debt originally contracted to the Morris Canal and Banking company, of $60,000, of which $20,000 was paid, and the mortgage for the balance of $40,000 is now held by A. G. Thompson, with whom an arrangement has just been concluded to defer the payment for 4, 5, 6 and 7 years,	40,000 00
Bonds issued in 1840 at 10 years, at 6 per cent. interest, for the Hempstead branch,	12,851 44
Bonds for rent and interest to the Brooklyn and Jamaica R. R. Co., payable in 10 years from June, 1842,	57,922 00
Four year bonds issued to contractors, and for materials, due in 1845, 1846 and 1847,	37,309 05
Bond issued for iron, locomotive engine, materials, etc., due within the next six months,	12,384 24
Bonds at 10 years, issued to residents of Long Island, for money loaned at 6 per cent., and expended in the construction of the road,	16,825 00
	$277,291 73

The receipts and expenditures of the road, as far as constructed, and operated upon from May 1842 to May 1843, are as follows:

Receipts for passengers,	$46,241 63	$55,731 84
Receipts for freight,	9,490 21	
The expenses for the same period are,		
Interest on New York State loan,	$6,000 00	
Interest on State of Michigan,	1,506 62	
Rent to Brooklyn and Jamaica railroad company,	8,000 00	
For all other purposes, as expenses proper in conducting the road, including repairs,	37,134 74	52,641 36
		$3,090 48

The balance of $3,090 48, together with two instalments, of one-half per cent. each, or $14,500, called during the past year, has been expended in continuing the construction of the road, and for which sum, as well as all other moneys expended, vouchers are on file.

The distance from Brooklyn to Greenport, the proposed terminus of this road, is 95 miles; the portion now in operation from Brooklyn to Suffolk station, the present terminus, is 46 miles; of the remainder, 21 additional miles are graded, 16 of which are in direct continuation, and 5 miles more are graded at different points on the line and disconnected.

The terminus at Greenport, from which point it is proposed to connect with the eastern roads by steamboats, is of the most favorable character; the approach to it is on the direct line of the road, and trains may be run upon the wharf at that place, at which ships of 500 tons are moored, and from which steamboats of any draft of water may take passengers with baggage and burden cars at all times throughout the year.

It may be well to add that with a view to making Greenport the terminus of the road, it has been recently examined by a committee highly competent to judge, that this committee have unanimously decided it to be all that could be desired for that object.

The distance from Greenport to Stonington is estimated at 24 miles; and about the same number of miles to the proposed terminus of the Norwich and Worcester road, near Gales Ferry, to which point the latter road is under construction, and will be completed in November next. The time required for performing the distance from New York to Boston, on the completion of this road, may be stated as follows:

From New York to Greenport, 95 miles,	4 hours.
Crossing to the Norwich and Worcester or Stonington roads,	2 hours.
From thence, as now performed, to Boston,	4 hours.
Making	10 hours.

Annexed to this report will be found the report and estimate of the engineer of the work, James J. Shipman, Esq., by which it will be seen that the cost of completing the remaining portion of the road to Greenport is $350,000.

No amount is named in the estimate referred to, as required for the *right of way;* and it is believed that none, of any moment, will be required. The land has been ceded, for the most part, and in two cases only on the twenty miles of road recently constructed, where the owners of land were unwilling to give their land, the commissioners appointed to assess the damage gave but a nominal amount, probably holding in view the great advantage which would accrue to such land owners by the construction of the road.

The company have recently obtained a decision of the vice chancellor, by which they are relieved from the heavy expense of constructing fences

along the line of the road. This item of expense alone in the construction of the road has heretofore reached as high as nearly $2,000 per mile. *

It is proper here to add, without claiming more for this road than other roads may claim, that from the period of its first operation to the present time, upwards of 750,000 passengers have passed over it without injury to a single individual. * * * * * *

Having placed before the stockholders the condition and prospects of the company, they would call their attention to the report of the engineer with regard to the cost of constructing the remaining portion of the work. By this estimate it appears that the sum of $330,000 is necessary for that object. By the experience acquired in the construction of 20 miles of road within the last 18 months, it is believed that the estimate is a fair one, and that of this sum, $250,000 would be required in cash, and that the balance could be obtained on a credit of from 1 to 4 years.

If the estimate referred to be correct it would seem for the interest of the stockholders to have the road completed as early as it could be done, consistently with a due regard to economy.

It is proper to state that some of the stockholders are urgent upon the board to complete the road with all practical dispatch, and place the company in a condition to pay dividends; and they also contend that the present condition of the money market, and the low price of materials, are unusually favorable for that object, and those holding these opinions profess their readiness to pay on their own stock. These representations coming from responsible sources, are doubtless entitled to some weight. The board of directors wish to pursue only such a course as will conduce to the immediate and permanent interest of the stockholders and the public.

The board are of the opinion that the time has now arrived when it becomes expedient to make a vigorous effort to complete the Long Island railroad from its present terminus to Greenport, and which can only be done with a due regard to economy, by raising funds from the stockholders sufficient to meet the expenditures. The president has accordingly been authorized and directed to call an instalment of one dollar and a half per share, payable on the 1st July next.

This matter is now submitted for the mature consideration and decision of the stockholders, with the single remark, on the part of the board, that in every view which they have been able to take of the subject, the conclusion is irresistible, that the expenditure upon this road, of the sum stated, will immediately and permanently enhance the value of the stock far above its present cost, and bring into successful operation a work, the extent and productiveness of which, (with a single exception,) it is believed, will exceed that of any other road in the middle or northern States.

By order of the board,

Geo. B. Fisk, President.

Yew York, June 15, 1843.

ENGINEER'S REPORT.

To the President and Directors of the Long Island Railroad Company.

Gentlemen—I have the honor of submitting the following brief report and estimate of the cost of the graduation and superstructure of the Long Island railroad from its present termination in Suffolk station to Greenport.

In making this estimate I shall omit taking notice of the cost of right of way, and the necessary docks and other fixtures required at Greenport, for which I have no data, and I shall take the present contract prices, considered as payable wholly in cash, as the basis of my estimate, the cubic yards

of excavation being increased to cover the grubbing and clearing. The item of masonry is also omitted because we have but two culverts on the line of more than 12 feet span, and those, owing to the entire absence of stone along our line, are made of timber truss work, the cost of which is estimated under the item of superstructure.

Estimate of excavation from 2d division to Greenport.

690,500	cubic yards at 8 cents per yard, - -		55,240 00
250,000	" " completed at 8 cents per yard, - -		20,000 00
440,500	" " balance unfinished at 8 cents per yard,		$35,240 00

I submit also an estimate of the superstructure:

4128 tons iron rail and spikes at $60, -	$247,680	
Mud sills and ties for 48 miles at $420 - -	20,160	
Workmanship, " " at $400 -	19,200	287,040 00
		$322,280 00

I would also state that the character of the graduation is such that it may be completed nearly as fast as the iron can be laid down, and that the retracing of the line beyond Jamesport would require a month or six weeks time, while the whole line from Jamesport west is now ready for the contractor. The whole line can be completed as respects graduation in four months without any question, and we have at this moment twenty-three miles in readiness to receive the superstructure.

The condition and prospects of the work under your direction will, I conceive, justify me in congratulating the stockholders and directors upon the near prospect of its early completion. The whole extent of our country, from one extreme to the other, will not present a line possessed of similar advantages, its western terminus at two great cities, Brooklyn and New York, the mainsprings of energy and enterprize, with a population of 360,000—its construction through the centre of an island itself containing 100,000 inhabitants, entirely free from navigable rivers, without a bridge for an hundred miles, and with grades of an average less than ten feet per mile; having six curves only, with radii not less than 5000 feet in 80 miles, admitting of any desired velocity, and with its eastern termination on one of the most beautiful harbors in the Union, within 5 hours of the city of Boston in all weathers. We may in brief, sum up the advantages you possess to enable you to withstand all competition in the following particulars, the shortest possible distance, the greatest velocity, the most perfect and solid superstructure at an expense less by 40 per cent. than any similar road in the world, and finally, a capacity of performing a profitable business at the lowest prices. All these are advantages inherent in your enterprize; and entirely independent of all improvement in machinery, which other machines may supercede, for no invention can nullify the fixed and immutable laws of nature; these devices serve only to economize power by new modes of application, which, owing to your unrivalled position, will still farther increase your capacity for business. I cannot believe that an enterprize so full of the elements of success will be suffered by the intelligent and active officers at the head of its affairs any longer to linger out a sickly existence when the land of promise so invitingly lies before them, and nothing more is required than to reach forward and possess that which they have so manfully struggled to obtain.

Respectfully submitted,

James J. Shipman, Chief Engineer.

READING RAILROAD AND THE COAL TRADE.

We were not a little surprised to find, while on a visit to Philadelphia a short time since, an apparent hostility among the citizens to the *Philadelphia, Reading and Pottsville railroad.* That there should be among those interested in rival works, a degree of hostility towards this road, which is likely to prove so formidable a rival, is not very surprising, but that others, whose interest is apparently in no wise interfered with, should evince hostility to *such* a work, is truly surprising. It is said by some that the Schuylkill Navigation company could bring down all the coal that can be mined in the Schuylkill region, and therefore a railroad was unnecessary. Possibly all the coal of the Schuylkill region might for some years yet, come through the canal, and at the old price of $2 00 per ton, yet, even if it might, that is no reason why other means of transportation should not be prepared *in time*, by which the supply of coal may be increased, and by competition—aye *competition*, there's the rub—in transportation, as in mining, the *price reduced*. It is hardly to be supposed that consumers will find fault with a measure which tends directly to reduce the cost of coal, unless perchance they have interests adverse to a reduction, either in *coal mines*, or other *modes* of transportation, yet we found many individuals who appeared decidedly opposed, if not hostile to this great work, which promises to be of vast benefit to community, by a direct reduction in the price of coal, the consumption of which is rapidly increasing in all parts of the middle and eastern States.

In 1842, over 540,000 tons of coal were sent from the Schuylkill mines, by canal and railroad, and it is now believed that over 600,000 tons will be sent this year. The cost of delivering this coal at Philadelphia, on the wharf and on board vessel was, previous to the competition of the railroad, over two dollars per ton; now by the railroad, it does not exceed $1 40—thus effecting a saving to the consumers of the 540,000 tons shipped last year of $324,000, and this saving was effected by the Reading railroad. Boats of the Schuylkill Navigation company are now carrying for 70 cts., and toll 54 cts. per ton, which with the unloading and re-shipping on board vessels at Philadelphia makes it over $1 40 per ton on board of vessel or in the depot of the company, thus making a saving to the consumer on the 600,000 tons from the Schuylkill region of $360,000 the present year. But this is not all the advantage, or economy to the consumers of coal. The whole amount of coal sent from the entire anthracite region of Pennsylvania in 1842, was 1,108,001 tons, only a fraction more than *double* the amount from the Schuylkill region alone. The Schuylkill is, we believe, the favorite in every market—of course, then, a reduction in the price of Schuylkill, of which so much is used, will carry all other kinds with it, and, therefore, we may safely assume that the Reading railroad has produced a saving to the consumer of sixty cents per ton on the entire amount sent to market, which will, this year, no doubt, be equal to, if not greater than last year—and amount to over $600,000.

But to understand fully the value of this improvement, we must look to the future. The *entire* consumption of anthracite coal in 1822, was only 2,240 tons—of which not a bushel came from the Schuylkill mines. It was not till 1825 that coal was sent to market from that region which now supplies one-half, into a few tons, of the entire consumption. In 1832—363,871 tons were sent to market—in 1842, 1,108,001 tons—may we not assume that the increase will keep pace, for ten years to come, with the past ten? and that in 1852, there will be at least 2,500,000 tons sent to market? We think so—and that they will be prepared to transport from the Schuylkill region, and deliver it on board of vessels, or in the yards at Phil., for $1 12½ per ton.

It is asserted by some that the railroad cannot compete with the canal—and, therefore, that it can never succeed; as to *competing* with the canal, *that*, we presume, is not the object of the railroad company. We suppose their intention is to carry the coal to tide water at a price, and in a *manner*, satisfactory to the dealers, and we have no doubt of their ability to do so, when they shall have laid their double track from Reading to Pottstown, and have increased their cars and engines according to their present designs.

Few people, indeed, who have not visited this railroad, can appreciate its great advantages for heavy transportation. The entire line from Pottsville to Falls of Schuylkill, 88 miles, is either level or descending, and, therefore, with *good* cars and engines, there is scarcely a limit to its capacity to transport coal, as will be seen by the statement, on another page, of Mr. G. A. Nicolls, superintendent of transportation, in relation to the performance of "Monocacy," a locomotive built by the Newcastle Manufacturing company, at Newcastle, Delaware. It is believed that that engine would have readily taken *twenty* additional cars; making up the load to 400 tons nett, exclusive of *cars*, and without injury to the road—thus establishing, beyond question, that they may at all times rely upon good engines' taking 200 tons of coal, or 66 cars, and more if necessary; and thus with thirty locomotives for freight and 2,500 coal cars, they can average *ten trains* a day, or 12,000 tons a week, or 600,000 tons a year—allowing two weeks for snow storms—which at $1 40 per ton, gives $840,000 a year for coal alone, without reference to passengers and ordinary freight, which will, in a few years, become an important item. It may be said that this calculation cannot be realized at *present*, and it may be as truly said that in ten years, and much less, it *will* be realized, and *exceeded* by fifty per cent.

It is said by some that this road cost too much. It has truly cost a *large* amount of money, over $5,500,000. Yet it must be taken into the account that the great object in view has been to obtain the *most favorable* grade possible, for a *heavy* trade *one* way, and to accomplish this, *rivers* have been bridged, *vallies* filled up, *hills* cut down and *mountains tunnelled*. The gentlemen in charge have judged wisely that for a heavy trade, a *good* road was necessary, and they have made such a road—notwithstanding the natural difficulties, the unceasing opposition, and the general depression of business operations for several years past.

There are three tunnels on this road, one 962 feet, one of 1,600 feet and one of 1,932 feet in length, by the last of which a bend in the river is cut off and the distance of several miles saved. The passage through this splendid tunnel and over the river, on a beautiful curved stone bridge, as the train emerges from total darkness at great velocity, is truly grand; and indeed the beautiful and highly cultivated valley of the Schuylkill nearly the whole distance to Pottsville, and the great variety of beautiful scenery constantly presenting itself to view when approaching the coal region is exciting beyond description. The passage of boats on the canal, loaded with coal, in one direction, at three miles an hour, while the cars are going at the rate of 20 miles in another; the assembling of cars loaded with coal, on the railroad from different directions; and the puffing of half a dozen locomotives, waiting with long trains of cars attached, for the arrival of the up train; the delightful and bold scenery breaking upon the view as the train winds among the hills, and the flourishing busy village of Pottsville, all tend to render this one of the most delightful excursions that can be enjoyed in the vicinity of Philadelphia; and a little effort and management and perseverance are only necessary, to render it one of the most frequented by the lovers of nature and the country—until the vicinity of the railroad becomes studded with beautiful country seats. But to effect this the system of "*low fares*" must be adopted. And here a word to the managers of the road, which, however, we must defer until our next number.

UNITED STATES NAVY.

The Army and Navy Chronicle presents the following *glowing* picture of the condition and mismanagement of the United States ships of war. It cannot be denied that there has been a gross waste of money in this department of our government—especially in the abortive early attempts at *steam frigates.* If the government would contract with individuals or companies for the construction of a few steam vessels of the various descriptions desired to come up to a certain standard—or not to be taken by the government—and then give *future* contracts to the most successful competitors, we will guarantee that as many steam ships, of the most improved construction, as may be desired by the government, will be furnished at three-fourths, or even *two-thirds* the cost of those built at the navy yards, where it is well know that labor does not *always* produce the greatest effect.

A GALVANIZED STEAMER.

Besides the sloop of war that has been ordered to be built at the Washington navy yard, we understand preparations are making also for building an iron man of war steamer. We have not understood what is to be her size—*small,* though, we hope. This business of steam men of war is new, and our true policy with regard to it is contained in the Spanish *refran, poco a poco,* senores. In the building of the Mississippi and Missouri, we have overshot the mark; precisely as we did in laying down the keels of so many 74s just after the war. There was the Independence, 74; she performed one short cruise, we think it was; and to be of any service had to be razeed down to a frigate. There is the Washington, 74; she has been once to the

Mediterranean and back, and she has now to be broken up as not worth repairing. There is the Franklin, 74; she has been one cruise to the Pacific, and a short time in the Mediterranean. She is hogged, and is now to be sent round to Boston, (*if the New Yorkers will let her*, for they have been making great efforts to retain her there,) to be cut down into a frigate. Then there is the Columbus, 74; she has also performed but one or two cruises, in a life time of twenty odd years, and will, when she returns, perhaps, never perform another as a ship of the line. There's the magnificent 120 gun ship, the Pennsylvania, rotting at her anchors; and we have heard doubts expressed as to whether she would even now be sea worthy; at all events, it is a question which in all probability will never be put to the test, unless we should have war very speedily. The Ohio has been in the water for twenty odd years, and has been one cruise. The Delaware is now abroad and the North Carolina is at New York. Besides these, there are on the stocks, where they have been kept since the war fever for 74s subsided, the Alabama, the Vermont, the Virginia and the New York. Any two of these could have performed twice the service that has been required of them all put together. And so far, we have been quite as unfortunate with steamers. The old Fulton got as far once, we believe, as Sandy Hook; she put back, and laid at the navy yard wharf for years, until she was accidently blown up. Her modern namesake is an egregious failure, is not seaworthy, and will never repay the navy or the country for the consumption of one day's fuel. The Mississippi has proved too expensive, and has shown the country that "it costs more than it comes to," by a long shot, to keep her at sea; therefore, she has been put out of commission and laid up. The Missouri, after the same order, has been made the subject of the most silly experiments. She also will teach a similar lesson—that large steamers, like large ships, are not the thing. We have no colonies abroad at which we can found naval stations, and erect depots and magazines for the safety in war of our man of war steamers on the other side of the globe. If we have them never so large, they must always turn homeward for fuel in war. This being the case, we want small ones rather than large. The cost and expense of the Mississippi and Missouri would build and keep in commission some ten or a dozen small ones, of three or four hundred tons each. In peace, each one of these would answer all our purposes quite as well as the largest; and in war, all of them together would be much more efficient and desirable than the two large ones. But in expressing our preference for small steamers over large ones, we wish distinctly to put in a *caveat* against those who have been tinkering with the Missouri having anything to do with hull, engines, boilers, furnaces, or smoke pipes of the one about to be built. Being of iron, too, it is an experiment; therefore, we repeat, *poco a poco caballeros.* Do not let the navy bleed to death with experiments. Let her be of the smallest class of war steamers, so if there should be a failure about her, or any great mistake, or any room for improvement, or any new discoveries which may injure her usefulness or render her unserviceable, let the loss fall lightly, where losses have been so frequent and so heavy—as Jack would say, "ease them off handsomely." Economy is the word now. It is the only thing, and that, too, of the most rigid kind, that can save the navy. As good citizens, as friends of the navy, we go for it; and whatever is at variance with it—henceforth, whatever is wasteful or extravagant in naval expenditures, it shall be our highest duty to expose and rebuke.

BOSTON AND FITCHBURGH RAILROAD.

The *fifth* important line of railroads, radiating from Boston, it will be

seen by the following notice, is in course of rapid construction. Thus it is that the Atlantic cities except New York, are all pushing forward important lines of railroad—opening easy and rapid modes of communication with the interior and with other cities, by which they can compete successfully with New York in supplying the country with merchandize, and at the same time interrupt our usual supply of produce; and if we are not more enterprizing we shall have to send to Boston for our supply of milk, butter, eggs, etc., as we have already for pork, which can be done in a year or two with great ease, or as soon as the *Long Island* railroad shall be completed, which we believe is now in a fair way to be accomplished.

Boston has her railroad to *Providence* in Rhode Island; to *Albany* in New York; to *Concord* in New Hampshire, and to *Portland* in Maine; and now she is pushing *for Burlington* in Vermont; and will reach there, too, in less than five years. And adopting the policy of "low fares," by which they are sure to attract the business and travel from a vast extent of the most populous and enterprizing portion of the Union.

Philadelphia, too, has her Columbia railroad and canals to Pittsburg; the Camden and Amboy road, and connection with the road from Trenton to New Brunswick and New York; the railroad to Wilmington and Baltimore; her Germantown and Norristown railroad; and last—but by *no means* least important—her *Reading* and *Pottsville* railroad: besides her numerous canals, by which she is supplied with the necessaries and the luxuries of life at all times, and at rates more in accordance with the times than in New York; and she can, also, and *will* furnish large supplies to the interior, which would be sought for in New York, if her citizens were as well accommodated with numerous and rapid modes of communication. So also with Baltimore, with less than a third of our population, but *double* our far-seeing enterprize and public spirit, she has *four* important lines of road in as many different directions, all now in successful operation. The distance now from Baltimore to Philadelphia is only 6½ to 7 hours; whereas a few years ago it was by no means *certain* how long. 'Tis true, on this road, they hold to the absurd high rate of fare, $4, which should be *at once* reduced to $3, or even to $2 50.

The Susquehanna railroad, connecting Baltimore with the *Garden* of Pennsylvania, and opening a direct communication with Pittsburg and the *far west*, is an evidence of her enterprize; and it is to be hoped that it may richly repay those who have invested their capital in it.

The railroad to Washington as well as that to Philadelphia, were matters of *course*—works *not* to be avoided in this go-a-head age—yet the people of Baltimore are nevertheless entitled to great credit for constructing so good a road as that to Washington, at a period when engaged in so many other important works of great magnitude. But the *eminently great* work, undertaken by Baltimorean enterprize, and at a period, too, when the capacity and importance of railroads was but little understood, is the *Baltimore and Ohio* railroad, designed to open a direct and rapid intercourse with the

vallics of the *Ohio*, *Mississippi* and the *great west*; a work which will insure a rapid advancement, and prosperity commensurate with the boldness of the undertaking and the indomitable perseverance with which it has been prosecuted more than half the distance, and into the immediate vicinity of a vast coal and iron region.

Thus have *Baltimore*, *Philadelphia and Boston* shaken hands with the *people* in all directions, invited them *to dinner* and treated them to the delicacies of their extensive markets—who will of course reciprocate their civilities and send them milk, butter, eggs and bacon in return. While *New York*, the great *natural* depot for the *eggs*, *milk* and *notions* of the whole country is resting upon her *laurels!* in having 14 miles of *Harlem* railroad, 45 miles of *Long Island* railroad, 53 miles of *New York and Erie* railroad and the privilege of *using* the *New Jersey* railroads!!!

Fitchburgh Railroad.—This excellent project, which connects with the Fresh Pond railroad, starting from Charlestown, is one of those railroads in the State which have asked for no assistance from the legislature, but has been commenced and carried on by the might of its own energy and enterprize. It is now in a condition of great forwardness, and, and will soon be finished. The subscriptions to the capital stock have reached $660,000. The road will pass through Somerville, Cambridge, Watertown, Waltham, Concord, Groton and Lancaster to Fitchburgh; and eventually to Keene, southern Vermont and lake Champlain. The first 27½ miles, extending from Fresh Pond to Groton, have been contracted for by Messrs. Belknap, Gilmore and Co., who built the railroad from Portsmouth to Portland. Seven hundred laborers are now engaged on the line. Five hundred tons of iron have been ordered by the Acadia, and the line will be opened to Waltham in September, in about four months after commencing operations.

LOCOMOTIVE ENGINES OF 1843, IN COMPARISON WITH THOSE OF 1829.

It is probably distinctly recollected by our readers that the Liverpool and Manchester railroad company, in April, 1829, offered five hundred pounds sterling for a locomotive engine, not to exceed six tons in weight, which should haul *twenty* tons on a *level road ten miles an hour;* and an engine of this capacity was then *unknown* in the world. Fifteen years, however, have made astonishing changes; locomotives are now in common use which will haul over 500 tons on a level road ten miles an hour. At that period, 30 feet rise to the mile was considered a serious obstacle, but now 70 to 85 feet rise to the mile is easily overcome with heavy trains, and with passenger trains at a speed of 15 to 18 miles an hour. The following statement of the performance of the "MONOCACY" engine, built by the Newcastle Manufacturing company, at Newcastle, Delaware, under the direction of *Andrew C. Gray, Esq.*, exhibits an improvement in railroad machinery truly astonishing, and commends highly to railroad companies the engines of that establishment.

Statement of the performance of the "Monocacy" Engine with a train of one hundred loaded coal cars on the Philadelphia, Reading and Pottsville railroad.—April 28th, 1843.

The above engine left Pottsville at $6\frac{1}{4}$ A. M., and passing six coal, passenger and freight trains on the road, arrived at the Falls of Schuylkill, 88 miles from Pottsville, and 6 from Richmond, at 6 P. M.

The time actually consumed in *running*, was 6 hours and 50 minutes; or at the rate of $12\frac{9}{10}$ miles per hour the whole distance. The train was taken up the forty-three feet grade at the Falls in two drafts, assisted by another engine, and reached Richmond, 94 miles from Pottsville, at $7\frac{3}{4}$ the same evening.

Nett weight of coal, 335 tons; of cars, 205 tons; making the gross weight of train, not including engine and tender, 540 tons of 2240 lbs. Whole length of train, 1250 feet; amount of freight on coal, $498.

The above train was fully within the power of the engine; the latter working with great ease during the whole trip.

The Monocacy is an eight wheel engine, built by the Newcastle Manufacturing company, Newcastle, Delaware.

Whole weight of engine, in running order, with water and fuel, $13\frac{6}{10}$ tons —do., on 4 drivers, $8\frac{13}{100}$ tons—cylinders 12 by 19 inches.

G. A. Nicolls, *Supt. Transportation.*

STEELED JOURNALS AND CHILLED BOXES.

When on a recent visit to Newcastle, Delaware, a few days since, we learned that the use of steeled journals and chilled boxes in railroad machinery has effected a more important change in the economy, of the few roads which have as yet adopted them, than is generally known. When well made and properly used, the chilled box and steeled journal axles for passenger or freight cars, are decidedly preferable to any other form of journal or box. They combine strength, entire security, freedom from friction and cutting, and durability to such an extent, that on the roads where they are used, nothing better is hoped or looked for. Not a drop of oil is necessary. a pound or two of palm oil mixed with tallow will be sufficient for an eight wheel car for months.

On the Newcastle and Frenchtown railroad, where they have used the same chilled wheels, steel journals, and chilled boxes for *six* years, a recent inspection of them has shown them to be now as good and perfect as they were on the day they were first placed under the cars. The large eight wheeled freight cars on that road have been running every day since the 20th March last, and have not cost one cent for unguents of any kind, and the determination of the agent of that road, is to run the same cars until the winter, without additional oil or grease. An instance of one of these journals and boxes fracturing on this road has not been known. On the Charleston and Hamburg railroad, in South Carolina, the same description of boxes and journals, as we are informed, are used with equally satisfactory results.

Captain Robert H. Barr, the agent and superintendant of the Newcastle and Frenchtown railroad, has in his possession some interesting facts in reference to the use of these articles which were promised us for publication, and he will be willing at all times, we dare say, to communicate the results of his experience to those interested in the management of railroads.

We were also shown a wheel on one of the freight cars, cast with a wrought iron ring in the rim, which was broken by accident, and yet it has been in *constant use* for several years, and apparantly as safe as any other wheel in the train. This illustrates very clearly the value of wheels cast with the wrought iron ring in the rim, and we would recommend those railroad companies, who have never used these very important improvements, to adopt them, and to send to A. C. Gray, Esq., for information in relation to them, as well as for the work when wanted, as we have good reason to believe that it is to be relied on in all respects.

PROGRESS OF RAILROADS IN EUROPE.

We give in this number, from the London Morning Chronicle, an interesting account of the progress of railroads in Germany. The Emperor of Russia is also pushing forward his great work from *St. Petersburg* to *Moscow*, and *designs*, we doubt not, to continue it to the shore of the Caspian sea. He has drawn into his service able engineers, machinists and mechanics, from *this*, and we presume also from *other* countries; and has large orders for machinery in course of execution, now, both in Philadelphia and Baltimore, which are to go out this season. Indeed, but for the *foreign* orders for locomotives, excavators and other machinery, many of our industrious mechanics would be now without imployment.

We understand that Major Whistler, who has charge of the railroad, is highly esteemed by those in whose service he is now engaged; and also that Mr. Joseph Harrison, of Philadelphia, and Mr. Thomas Winans, son of Ross Winans, Esq., of Baltimore, both of whom have gone out to superintend the erection of large machine shops, under the patronage, and at the expense of the government, are well satisfied with the reception they have met with.

Thus it will be seen that the *monarchical* governments of Europe duly appreciate the vast importance of railroads as a means of controlling the people; but if we are not mistaken, *railroads* are the precursors of *liberty* and *equlity* to the *people* everywhere. *Intelligence* leads directly to liberty and equality, and railroads cause the "*schoolmaster to be abroad.*"

MISSING NUMBERS OF THE JOURNAL.

If any subscriber to the Journal desires to supply missing numbers to any volume since July, 1838, they are requested to give *early* notice, that they may, if possible, be supplied now when we have some odd and surplus numbers on hand.

EXTRAORDINARY PHENOMENON.

A singular discovery was recently made in the office of the Railroad Journal and Mechanics Magazine, when its former editor and founder returned to his old station, after a long disconnection from it. On looking about the office he discovered that one very important book, the *Ledger*, was out of its place. It was replaced on the shelf, where it belongs, but, singular as it may appear, whenever he returned to the office, after a short absence, the Ledger was out of its place, which induced an investigation into the cause of the occurrence. After dilligent search, and due deliberation, we were led to the conclusion that this singular phenomenon—*if it is* singular in publishing offices—can only be accounted for in the following way. On turning over the leaves, he discovered that on *one* side of the page there were numerous entries, thus—A. B., *Dr.* £1—C. D., *Dr.* £2—and E. F., £3—and so on through the alphabet; whereas, in very many cases—*quite too many* for the interest of the editors—there was *no corresponding* entry on the *opposite* side, and on adding up the two columns, he found a difference of £500 or £600 in (the weight of) the two sides of the Ledger; thus accounting, in a very *natural* way, for the uneasiness of the—*Editors*, if not of the—Ledger. We shall be gratified to learn if any similar occurrence, from *like cause*, has ever been heard of. If there has been a *solitary* instance, it should be put on record for the benefit of future historians. And it is not, for a moment, doubted but that those, opposite to whose names these *blanks* occur, will *immediately* have them filled, so as to enable us to determine the cause of so singular an occurrence; and we would suggest the propriety of an experiment by which the ballance may be thrown on the *other side*, that we may be able to ascertain whether it will cause a similar tendency in the book to be out of place. Should it, fortunately for the Journal, for *once* get on the *other* side, and produce a similar propensity in the book, we will go security that the *Editors* will never complain—though, as in duty bound, they will certainly record a phenomenon so singular.

☞ And now, my dear sir, we ask your hearty co-operation in the good cause. We ask you to recommend the RAILROAD JOURNAL to others, as well as to take it yourself, and to remit the amount of their subscription with your own. We think it should be taken by Stockholders generally, and especially by Railroad Companies—several copies for each, to distribute among those in their employ—and that Railroad Companies should Advertise on its cover, that it may be sought for by travellers and others, and thus diffuse more generally, correct information in relation to the character of Railroad Stocks as an investment. If the different Railroad Companies in the United States would take five or ten copies each, and advertise their rates of fare, at $10 a year, the circulation of the Journal would soon reach 5 or 6,000 copies, and be the means of disseminating widely, information exhibiting the success of railroads in this country and in Europe, which now seldom reaches the people. And it is for the interest of every Road, and every Stockholder, and every Engineer, to have the subject better understood. We therefore request you to give us the benefit of your influence in extending the circulation of the Journal, and we pledge ourselves to labor diligently in the cause.

The EDITORS.

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Published MONTHLY, at No. 23 Chambers street, New York, at TWO DOLLARS A-YEAR.
By GEO. C. SCHAEFFER, and D. K. MINOR,

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5. | By GEO. C. SCHAEFFER, and D. K. MINOR, Editors.

No. 9, Vol. I. Third Series. | SEPTEMBER, 1843. | Whole No. 428. Vol. XVI.

The South Carolina canal and railroad company being hereafter merged in the Louisville, Charleston and Cincinnati railroad company, the present report is intended to give a general view of the affairs from the first organization of the corporation. A highly interesting history of the undertaking we have already extracted in a previous number.

This report by Mr. Tristram Tupper, late President, shows that great advances have been made in economy and good management, and throughout the zeal and faithfulness of this gentleman to his duties are well displayed.

But while admiring the industry with which the materials of the report have been collected we cannot but regret that the truth of certain statements in the preface had not been more fully investigated before publication. In endeavoring to exalt the value of the stock passing into the hands of the Louisville Cincinnati and Charleston railroad company, Mr. Tupper takes the opportunity of stating that the stocks of but *four* railroads in the United States are above par, while all others are *at*, or far below par. The statement is not only literally untrue, but is calculated to produce a bad effect upon this species of investment. We have no doubt that such a result was far from the mind of the writer, but still he should have been careful not to decry all other works in praising his own.

REPORT.

To the Stockholders of the South Carolina Canal and Railroad Company:

In accordance with the general usage of this company, and in conformity with one of its rules, a statement of its affairs, as made up by the secretary and treasurer, is herewith presented, showing the gross income of the half year, ending the 31st December, 1842, to be $182,678 05

And the expenditure for the same time, for improvement and repairs, 110,085 22

Leaving a nett income of $72,592 83

Being over the rate of 7¼ per cent. on the capital of $2,000,000; and showing a gain over the same months of last year, $28,519 89

In larger receipts, $18,929 22

And smaller expenditure, 9,590 67

This encouraging result has been presented in each of our semi-annual reports for the last three half years, exhibiting a gradual improvement in the

condition of the company; and it will be our duty to show in the present report, how our contracts and engagements might have been made to produce the company a much larger nett income, without materially affecting its general arrangements.

Since the 1st of July, the company have reduced its indebtedness $72,592 83.

From amount then due,	$212,675 88
To amount now due,	140,083 05

The only remaining debt of the company, (except for incidental expenses for which we have cash in hand,) is $100,000 to the State of South Carolina, with interest, $53,253, payable in 1847.

The accounts thus show a surplus of over $13,000, from which a dividend might be safely made of one-half per cent., but we believe it more advisable to retain it until July, when a full dividend of at least $3\frac{1}{2}$ per cent. can be made.

Since the 30th June, 1839, the balance due by this company, over its assets, have been reduced from the nett income, $355,121 57

The amount at that time,	$495,159 62
And at this time,	140,038 05

embracing the amount borrowed from the Louisville, Cincinnati and Charleston railroad company, to complete the improvements of our road to that date, $332,182 10

With interest since credited,	39,914 14
Making amount paid that company in full,	$372,096 24

This fund would have paid dividends to the amount of $18\frac{6}{10}$ per cent., if not applied to the payment of debts, or about $5\frac{1}{3}$ per cent. per annum, during a period of the most depressed state of trade, perhaps ever known.

And whatever may be the state of trade for the future, it is believed that the low amount to which the expenses of our road is reduced, (compared with former years,) will enable it to produce a handsome profit to the stockholders.

In my July report, it was stated that "the current half year will, no doubt, on both roads, furnish a nett income of not far from $100,000." It appears that the amount realized is $101,600 37. It was also stated, that at least 60 setts of chilled wheels and axles, with steel journals and chilled boxes, would be made in the work shops during the ensuing six months, and that the platform cars would be increased to 30 on eight wheels—63 setts of the wheels have been cast and fitted to axles, and the 30 platform cars completed, which aid much in the transportation of cotton.

The report of the superintendant of the road, (Mr. Lythgoe,) will show the progress and improvement of his department—and by the contracts he has made for the ensuing year, the amount of wages will be further reduced, notwithstanding there has been to this time a gradual reduction for the last six years in this item of our expenses.

There is strong reason to believe that the effort made to preserve the timber for repairing the road, by Earleizing it, will contribute much in lessening the consumption of this article, which is now less than half the amount used four years ago.

About four miles of road, at different points, have been laid with this prepared timber, besides several turnouts, without any additional expense in the road department; as we stated in our last report, the inferior sap-timber used is obtained for enough less than the heart-timber, to defray the expense of Earleizing—and so soon as the test going on in Sixth street, Philadelphia, (of inferior hemlock laid down in 1839,) is rendered sufficiently satisfactory

to warrant it, the whole road could be relaid with mineralized timber as fast as that now in the road is required to be removed, which may be done with diminished expenditure each successive year.

The report of the master of machinery shows the condition of that department, and the progress of improvement there; the economy in the work shops, for the last two years, is particularly interesting, and should be very gratifying to all who have a knowledge of it. We have in many things surpassed all similar establishments; our success in making such machinery as is required, particularly wheels, axles and boxes, and preserving them from wear while running, has exceeded all precedent, and will be a saving to the company of at least twenty thousand dollars per year in the machinery department.

Since the 1st of July, we have had cast 254 chilled wheels of the same quality commenced twenty-two months since, of which not one has yet failed, which, with the axles, having steeled journals, and chilled boxes, cost but one-half the price of any ever obtained from abroad; these are also used in the place of, and are much more durable than the wheels with wrought iron tires fitted with brass boxes, which have cost more than four times as much as these made here, of *condemned materials.* Their being fitted for the use of tallow, instead of oil, is a saving of nearly the whole cost of the latter, which, when used on the train, was applied every ten miles run, while with the new arrangement, where the boxes are well fitted, (after the first few trips, which wear the parts smooth,) there is little or no consumption of the tallow. In fact, the passenger trains, which have been particularly watched to ascertain the result, have not consumed as large an amount in tallow in twelve months as formerly was applied in oil in two trips. Oil is now only used in the work shops, and on such parts of the engines and cars as are not fitted for tallow.

The cost of oil and tallow purchased annually has been reduced from $6,500 worth in 1837 to $2,000 in the last year, and the number of trips much increased since the former period.

The engines built in our shops are more simply constructed, and consequently require less repairs than any we have had from Europe or the northern States. There is one now nearly finished, which, it is believed, will be capable of a greater performance than any one now on the road.

The position of our shops has given the master of machinery a greater opportunity to improve upon the locomotive engine, than perhaps any other machinist. Having been at the end of one of the longest roads a greater length of time, where he has seen every engine go out and come in, and obliged to correct their defects, and cannot have avoided discovering any disproportion of their parts, or any unsuitableness of the materials used in their construction, and must have acquired the best mode of adjusting and renewing these imperfections.

These views will be fully confirmed by reference to the general statement, showing the expenditure for the last seven years, where it will be seen that the annual cost of machinery and materials have been reduced since 1837 from about $90,000 in that year to $22,250
A saving in this department of $67,750
with only $6,000 increase of the work shop wages, when it must be recollected that the former year commenced with as great a number of engines as the last.

The extent of our work shops, although the buildings are inferior, and the perfection of the preparations there for carrying on the work, is producing an immense saving to the company, and these works are daily improv-

ing by setting up additional apparatus and machinery for facilitating the business of building and repairing engines and cars.

This economy has gone through the whole business of the company, as will be seen by the same general statement.

The aggregate of all the items of expenditure, except land, new iron and embankment, in the year 1837, was about **$377,000**
and the same items in 1842, 225,700
Showing this difference **$151,300**
in favor of the last year, with nearly double the business on the road.

This will be more satisfactorily explained by another statement, giving the cost of the miles run each year.

In 1837, 172,456 miles—$377,148 54 expenditure; $2 12½ cost per mile.

In 1842, 299,744 miles—$225,742 62 expenditure; 72 cents cost per mile.

It is proper here to admit that this great difference is not all obtained by economy, a considerable part of it is from the fact that many of the articles used are now purchased at a much lower price than formerly, and some part of the outlay in 1837, was for improvements not requiring to be repeated each year. These we will assume would have amounted to $50,000, or one-third the difference stated above. Such is the present condition of the property belonging to the South Carolina canal and railroad company, that it is now fully worth its cost to the Louisville, Cincinnati and Charleston railroad company, $125 per share, and including interest since purchased, $150 per share—and by allowing the purchasers of the stock to assume the debts of the Louisville Cincinnati and Charleston railroad company in part payment, for which this stock is liable, believe it might be disposed of at the above rate—or the whole property in the name of the South Carolina canal and roailroad company might be leased or "farmed out," agreeably to the provisions in the charter, (by giving all its privileges,) at the rate of ten per cent. per annum on the capital of two millions, for ten years, payable monthly in advance. The property to be preserved in its present good condition, and the transportation on the Columbia road, performed and charged at the same rate per mile that it should cost on the main road. The lessee to have the right, and be required to pay the interest on the debt of the Louisville, Cincinnati and Charleston railroad company, on account of the rent, as it is required by an act of the legislature, that the interest on the Sterling bonds be paid from the income of the South Carolina canal and railroad company.

More than a year since our attention was excited by the excavating machine employed at Fort Green, Brooklyn. We paid it several visits, and were highly gratified with its performance, but from not knowing who the proprietors were, we were unable to afford any satisfactory information as to the details of the machinery, or the cost of operating it. We at last found a very good and tolerably complete notice which was published in the number for March, 1842, p. 177.

The following description, together with an account of previous patents, for similar purposes, is from the London Journal of Arts and Sciences. We are indebted to Messrs. Eastwick & Harrison for the English cut which accompanied this article.

It must be recollected that this is the first excavating machine which has

ever gone into successful operation—in this country at least. Much interest is felt in it, and we have heard many inquiries in regard to the cost of working, and the circumstances of ground favorable for its use. From the want of notice on the part of the proprietors, we have never succeeded in obtaining this, though we have at times taken much pains to gather the desired information. Their own advantage should prompt them to give publicity to everything concerning the machine.

MACHINERY FOR EXCAVATING, OR CUTTING, AND REMOVING EARTH.

Many have been the attempts to supersede, by means of machinery, the use of hand labor in the tedious and laborious operations of cutting and removing earth, for leveling inequalities of the surface, forming canals and docks, and clearing the beds of rivers. These mechanical contrivances have necessarily partaken of the same general features, viz., moving peckers and shovels, or scoops, constructed and arranged in various ways, and actuated by wheels and levers, in a variety of forms and combinations, from the simple and well known dredging apparatus, commonly worked in our harbors and rivers, to the elaborate and gigantic new American excavator, which, under the absurd cognomen of the "Yankee Geologist," has been proclaimed to the world as capable of removing mountains.

Without intending, in the slightest degree, to detract from the merits of this American invention, which we hear from disinterested parties, who have witnessed its performance, to be one of paramount importance and vast capability, we think it necessary, in order to qualify the extravagant statements given in some of the periodicals of the day, both foreign and English, respecting its astonishing powers, to state what are the leading points on which its claims to novelty are founded.

In order to show this more clearly, it will be desirable to mention, in a brief way, the objects and features of the several machines for excavating and removing earth, which have been the subjects of patents within the last twenty years. The first of these we find to be the invention of George V. Palmer, of Worcester—a machine to cut and excavate earth, granted 8th June, 1830. This machine is mounted upon wheels, intended to advance upon a temporary railway, laid upon the surface where the excavation is to be made, beneath which a hole is dug to commence the operations in. There are a number of peckers in front of the machine, which by vibratory action, dig into, and thereby break up the earth. A consecutive series of buckets, connected by an endless chain, are brought down into the disturbed and broken ground, and scrape up the soil, stones, etc., which are carried away up an inclined plane, in the manner of the ordinary dredging apparatus. The machinery is worked by a winch and toothed gear, and advances upon its railway as the earth is broken and removed.—See vol. vii, page 314, of our second series.

Mr. G. V. Palmer, of Worcester, had a second patent granted, 24th January, 1832, for improvements in machinery or apparatus for excavating, and which he called an excavating and self-loading cart. This contrivance much resembled an ordinary cart upon two wheels, drawn by horses. Under the cart were placed the cutting, or excavating, instruments, formed something like the share and breast of a plough, which excavators were capable of being lowered, so as to take into the ground and break up the soil to any required depth, as it advanced; or they might be drawn up out of operation, in order to allow of the cart travelling on ordinary roads, when proceeding to, or returning from, its work. The running wheels of the cart were broad,

and their felloes hollow, and in these hollows were transverse partitions, formed by plates, which constituted the bucket wheels. On the cart advancing, the ploughs, or cutters, penetrated into and broke up the ground, and turned the soil sideways into the buckets of the running wheels, which, as they revolved, raised the soil, and, in turning over, let it fall on to inclined edges, by which it was conducted into the cart.—See vol. i, page 278, conjoined series.

In December, 1833, a patent was granted to Mr. Thos. Affleck, of Dumfries, for his invention of improvements in the means and machinery for deepening and excavating the beds of rivers, removing sand banks, bars and other obstructions to navigation. This, however, consisted merely of apparatus, which, when agitated by the rolling waves, or rise and fall of rivers, disturbed and broke up the mud, sand or gravel, for the purpose of enabling it to be washed away by strong currents, or freshets.—See vol. iv, page 273, conjoined series.

An apparatus to facilitate and improve the excavation of ground, and the formation of embankments, invented by Mr. William Brunton, engineer, of London, was made the subject of a patent, dated 2d November, 1838. A part of this invention was a series of hook-shaped cutters, fixed in a frame, one in advance of another, and which, being connected to machinery, were forcibly projected into the ground, and made to plough it up in grooves; each cutter, as it advanced, cutting and preparing the way for the next cutter in succession. The other parts of the invention applied to the arrangement of stages, and the order in which a series of workmen were to dig and remove the soil. Also, the manner of depositing soil for the formation of embankments; compressing it to give solidity; and conducting the earth-wagons, upon tram-ways, by endless ropes.--See vol. xvii, p. 284, conjoined series.

Mons. L. J. A. Ramel, a foreigner, obtained a patent in England, dated 19th March, 1838, for his invention of improvements in machinery for excavating and embanking earth, for the construction of railways, and other works. The specification of this patent does not set out in very clear terms what are the features of novelty proposed, but speaks of the "system of a lever." As far as we can understand the subject, it seems to be merely the adaptation of a long lever as a crane, which works vertically, to raise loads of earth in a box, in place of employing hand barrows, passing up inclined planes, or of pitching the earth from stage to stage by hand-labor. This lever is mounted upon a platform, with running wheels, for the convenience of passing it from place to place, upon a railway; and the lever, to one end of which the loaded box is attached, is worked by a cord, or chain, connected to the other end, and to a winding drum, or barrel, and windlass; and when the load of soil is conducted to the place of deposite, it is let fall into a cart, by opening the bottom of the box.

An invention of certain improved machinery for cutting and removing earth, was communicated to Mr. William Newton, of Chancery Lane, by a foreigner, for the purpose of obtaining a patent, which was granted on the 27th March, 1839. This invention is a peculiar arrangement and construction of apparatus, mounted in a carriage upon a temporary railway, in which a series of rotary cutters, or peckers, working in inclined positions, are made to break the ground below, at an angle of about forty-five degrees, as the carriage proceeds; and also to throw the earth, thus broken, into a consecutive series of buckets, attached to an endless chain, which, by travelling vertically, takes up the broken earth to the top of the excavation, and delivers it into a series of troughs above, which troughs, by moving in a transverse

direction, carry away the earth and deposite it in carts, or otherwise, as convenience may require.—See vol. xvi, page 57, conjoined series.

Mr. W. Scamp, of Woolwich, obtained a patent, dated February, 1841, for an application of machinery to steam vessels, for the removal of sand, mud, soil and other matters, from the sea, rivers, docks, harbors and other bodies of water. This invention consists merely of a barrel, studded all over with spikes, which, being mounted upon an axle, was suspended by lever arms from the vessel, and, on being lowered down to the bed, or bottom of the river, the barrel was made to revolve, as the vessel advanced, by a travelling endless chain, extending from a pulley, or spur wheel, on the axle of the propelling wheels; or, by other rotary means, to a pulley on the axle of the barrel, so as to cause the mud, sand, and other materials on the bottom, to be disturbed, or broken up, by the spikes, and on mixing with the water, to be carried away by the current.

These are all the schemes which have been proposed and brought before the public, under the protection of letters patent in England, within the last twenty years, until the introduction of the American invention above alluded to.

This machine, which we are not permitted at present to lay before our readers in all its details, consists of a horizontal platform, mounted upon wheels, carrying a strong jib-crane, and also a steam engine. From the end of this jib-crane, the excavating tool, or cutter, is suspended by chains and pulleys, which allow of its swinging in a forward direction; and the back part of the tool, or cutter, is attached to a rod, or beam, sliding on rollers, which being acted upon by chains and toothed wheels, in communication with the steam engine, causes the cutter to be projected, with great force, against the earth required to be broken up.

The mechanism and the suspending chains, connected with the steam engine, and with the projecting rod, or beam, affords the means of regulating and determining the course in which the cutting tool shall move forward; and by means of a small hand lever, a workman, standing upon the platform, is enabled to direct the advancing cutter through the ground, in a horizontal line, or through any inclined or curved course, up to a perpendicular; the movements of the pendulous chains determining the course of the cutter, while the sliding beam projects it forward.

The excavating tool is formed as a scoop, with strong tangs, or teeth, in front, to break the earth as it enters, and a sharp cutting edge to take up the broken fragments.

The machine having been moved upon its railway to the place where it is required to excavate, the platform is then made fast, pro tem., in that situation, and the steam power of the engine brought to act upon the mechanism, by sliding clutches, or other contrivances. The pendant tool, or excavator, is then forced forward by chains, connected to the projecting beam, and passed round a rotary drum, driven by gear from the engine; and at the same time, the pendant chain is drawn up, or let out, as may be necessary, to allow the excavator to advance in the required course. When the projecting beam has carried the excavating tool forward to its extent of action, in a horizontal cut, the suspending chain, from the crane-jib, will raise the loaded scoop, (or the projecting and raising of the scoop may be simultaneous, as the workmen shall direct,) which loaded scoop when brought to its highest position, may be conducted to one side of the excavation by the swinging jib, and the contents let fall into a cart, by opening the back of the scoop; all which operations are effected through the agency and power of the steam engine, under the direction and regulating hand of the workman.

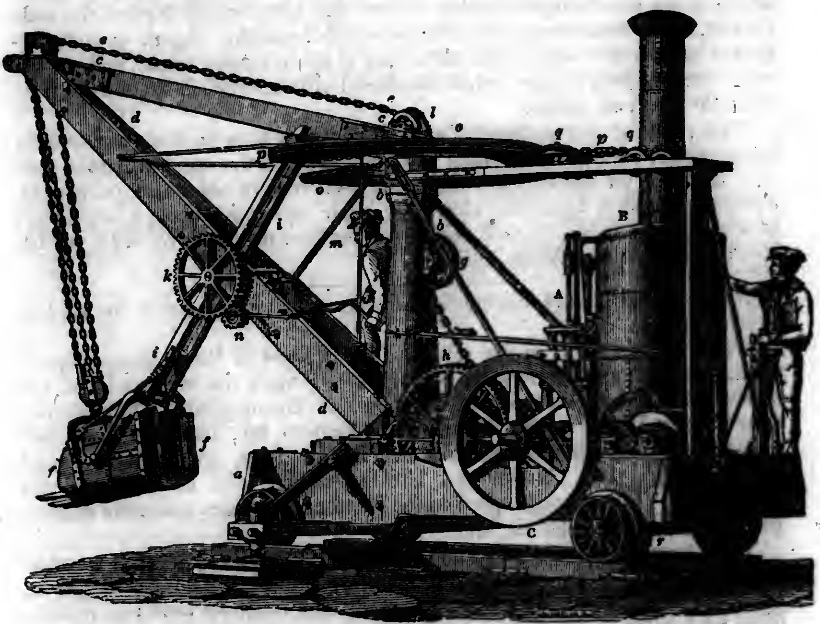
It is only necessary further to say, that by turning the jib of the crane to the right or left, the cutting of the earth may be performed at any angle to the direction of the machine, and, consequently, to a very considerable extent—viz., a circuit of forty or fifty feet—without shifting its situation; but when a change of place becomes necessary, the fastenings by which the platform was secured must be withdrawn, and the power of the steam applied to move the whole, upon its turning wheels, to the next place where it may be required to be made stationary.

Having given this brief description of the construction and mode of working the new American excavating machine, we conclude our present report by stating the points of novelty which it may fairly claim over others that have preceded it. Firstly, it is locomotive; its movements, and all its operative parts, deriving their powers from the steam engine which it carries. Secondly, that the earth is broken up and carried away from the place excavated by one instrument, (the scoop,) acting with immense effect, through the power and agency of steam. Thirdly, that the cutting may be made with equal facility at any inclination to the horizon, and to a great extent around the spot on which it is stationed, by the direction of the workman, without requiring to be moved from its place. Fourthly, that, by this machine, a channel may be cut through a hill, with the proper slopes for its sides, and a level base correctly formed, the excavated earth being simultaneously removed. Fifthly, the capability of cutting many feet below the base on which the machine runs, by lengthening its chains and guide-beam; which last feature renders it also applicable to working under water, when placed in a vessel, for removing sand banks, bars and beds of mud.

The engine and boiler, by which the various parts of the machine are put in operation, are shown at A B—*a a* is the framework, provided with wheels, by means of which the whole apparatus is capable of being moved along a temporary railway, as the machine digs away and removes the earth before it. The crane-post is shown at *b b*, at the upper end of which is placed the crane-jib *c c*, supported by the diagonal beam *d d*, which is also used for carrying certain wheel work and apparatus for effecting the required movements of the shovel. At each end of the crane are mounted pullies, over which a chain *e e*, passes from the shovel, or excavator *f*, and from thence down the centre of the crane-post, and under the carrier-pulley *g*, to a windlass, or capstan, on the axis of which is mounted a large toothed wheel *h*, taking into a pinion upon the main driving-shaft, on which is mounted the fly-wheel C. The shovel, or excavator, is connected by swing-joints to the forked end of diagonal arms *i i*, which are furnished with chains, attached to each end thereof. These chains pass once round pullies, mounted upon the axle of the toothed wheel *k*; and hence, on rotary motion being communicated to the said axle, the diagonal arms *i i*, and consequently the shovel *f*, will be caused to move upwards or downwards. The end of the shovel is connected by hinges to the other parts thereof, and retained in its proper position, during the operation of digging, by means of a bolt, or pin, which may be withdrawn, by means of suitable apparatus, when the filled shovel is raised by the chain *e e*, and swung round to the required position; the shovel will then tilt over, depositing the excavated earth in a wagon, or other required receptacle.

Upon the axle of the guide-pulley, on the top of the crane-post, is a beveled toothed wheel *l*, taking into a similar wheel, mounted upon a diagonal shaft *m*, at the lower end of which is a beveled pinion, taking into another, mounted upon the axle of a pinion *n*, which latter pinion is capable, by means of hand-levers, of being shifted in and out of geer with the wheel *k*; by

which arrangement, the chain *e*, passing over the guide-pulley, and communicating rotary motion thereto, will cause the pinion *l*, and shaft *m*, to revolve, and thereby, through the intervention of the pinion *n*, and wheel *k*, effect the required motion of the diagonal arms *i i*, and shovel *f*, the attendant being able to arrest the motion thereof, at any time, by means of the hand-levers connected to the pinion *n*.



The horizontal motion, or swinging round, of the crane is effected by means of the horse-shoe shaped pulley *o o*, affixed to the crane by cross-rods; to this pulley each end of a chain *p p*, is fastened, which chain, having passed round the periphery thereof, is conducted downwards, by means of guide-pullies, *q q*, passing once around an axle, driven by wheel-work, connected to the engine, which wheel-work is capable of being shifted in and out of gear with the main shaft, by the attendant, through the intervention of a hand-lever; by this arrangement, the chain *p p*, is put into motion at discretion, thereby causing the horse-shoe pulley *o o*, to revolve, and with it, the crane and shovel, or excavator. The machine is propelled along its temporary railway, as the work progresses, by means of a toothed wheel *r*, affixed on the axle of one pair of running-wheels, and connected to the motion of the engine by suitable gearing.

When the operation of excavation commences, the shovel is caused, (by the loosening of the chain *e e*,) to assume a nearly perpendicular position, the teeth thereof being turned towards the earth; motion then being communicated to the several parts, by means of their respective trains of wheel-work, the chain *e e* is gradually drawn tight, and wound around the capstan or windlass; during which operation the arms *i i* are brought into action, forcing the shovel into the ground by the means before described; hence it will be perceived that the shovel, or excavator, is operated upon by power exerted in two directions. the one through the medium of the arms *i i*, caus-

ing it to be thrust into the earth, the other through the medium of the chain *e e*, and its appendages, causing it to be lifted therefrom; by which combined action, and suitable speeds of driving gear, the shovel will describe a curve in ascending, the commencement thereof, being just in front of the machine, and the end thereof vertically under the front of the crane-jib. The shovel being filled with earth, and raised to this point, is swung round, by means of the horse-shoe shaped pulley *o;* and the bolt, which secures the ends thereof, being withdrawn, the contents will fall into the wagon, or other required receptacle; after which, the crane is again swung round, and the various parts put out of gear, when the shovel will descend, in order to operate upon the earth as before.

This peculiar arrangement of apparatus, it will be seen, is applicable only to operations performed on land; but a machine on the same principle, suitably modified for the intended work, has been constructed for the purpose of dredging harbors, deepening rivers, or other such operations, a description of which, with a more minute account of the first machine, we shall lay before our readers at a future time.

Railway Speed and Safety.—The following paragraph is from a late London paper:

"The returns given in the report of the officers of the railway department, board of trade, shows the average speed upon the various lines, exclusive of stoppage, as follows: London and Birmingham, 27 miles per hour; Great Western, 33; Northern and Eastern, 36; North Midland, 29; Midland Counties, 28; Manchester and Birmingham, 25; Newcastle and North Shields, 30; Chester and Birkenhead, 28; and Birmingham and Derby, 19. The average speed on the Metropolitan lines, exclusive of stoppages, is about 22 miles an hour.

The foregoing returns of speed on the English railways shows an average rate exceeding the rates in this country, say 19 to 20 miles per hour. On some of our best roads, with the heavy edge rails, we have accomplished as high rates of speed, to wit, a mile in a minute, as was once performed in England. Our engines have drawn larger loads up higher grades in comparison to their weight. The great difficulty with most of our roads is, that they are too slightly built, from the dificiency of capital in this country. There will be no difficulty with a good road, *and none other should be built,* between this city and Albany, in accomplishing the distance in six hours, which is only 25 miles per hour, a speed 33 per cent. less than that performed on the Northern and Eastern railroad.

Mr. Lang, in a report to the London board of trade, shows by a number of facts, "that railways are the safest of all modes of conveyance, and more particularly safe than steamboat travelling." From 1st January to 1st July 1841, only three lost their lives from causes beyond their control. The number of passengers travelling was 9,122,000. The distance travelled, 182,-440,000 miles. The number killed from causes beyond control were one to 3,040,666. Only one passenger lost his life for each 60,813,333 miles travelled. J. E. B.

If any one of our readers can make anything out of the following announcement, we will cheerfully yield him our editorial pen and scissors, and resign.

Revolving Steamer.—We have unintentionally neglected to speak of a model of a vessel, that has been exposed to public inspection at the St. Charles Exchange, which has been the subject of no little speculation. The

vessel is composed of a number of air-tight boxes, connected together by hinges, which revolve over two wheels at the extremity of the boat. There are two sets of these boxes, and the engine is to be fixed between them. When the machinery is put in motion, the wheels which keep the "chain of boxes" distended revolve with rapidity, and the boxes of course pass around them. At the top of each box is a fixed paddle intended to take hold upon the water as it revolves. By this contrivance it is thought by the inventor that the vessel will be propelled with nearly the same velocity through the water as it has no water to displace by pressing through it, but roll over its surface. The revolving boxes, air tight, are in fact the vess itself.---*New Orleans Bee.*

Electro-Magnetic Telegraph.---We are gratified to state that the board of directors of the Baltimore and Ohio railroad company has given permission to Professor Morse to use the track of the Washington road for the purpose of carrying out the intentions of the act of Congress in reference to his important invention of the electro-magnetic telegraph. One station of the telegraph will be at some appropriate place in the city of Washington, and the other in the city of Baltimore, and the communication between them will be effected by properly prepared wires laid along the line of the railroad. The object of this arrangement is to prove what Professor Morse has already most satisfactorily shown on a less extended scale, that the lengh of the line of communication presents no obstacle whatever to the instant transmission of intelligence between the two extremes, either by day or night. We predict for this ardent votary of science the triumphant success that he so well merits.---*Baltimore American.*

Ballooning the Atlantic.---Mr. J. Wise, the celebrated balloonist, gives notice to all the world, that he will very shortly make an ærial trip with his balloon across the Atlantic. He thus concludes his communication:

The balloon is to be 100 feet in diameter, which will give a nett ascending power of 25,000 pounds, being amply sufficient to make every thing safe and comfortable. A seaworthy boat is to be used for the car, which is to be depended on, in case the balloon should happen to fall in accomplishing the voyage. The boat would also be calculated upon in case the regular current of wind should be diverted from the course by the influence of the ocean, or through other causes. The crew to consist of three persons, viz: an Æronaut, a Navigator, and a Scientific Landsman.

Therefore, the people of Europe, Africa, Asia, and all other parts, on the ocean or elsewhere, who have never seen a balloon, will bear in mind, that it is a large globe made of cloth, ensconced in a nett work, with a sloop hanging underneath it, containing the "latest news from the United States," with the crew of the world's obedient servant. JOHN WISE.

Lancaster, Pa., June 8th, 1842.

KITE'S PATENT SAFETY BEAM.

We have frequently noticed this truly valuable railroad invention. It is simple, cheap and effectual, while there is no other method of accomplishing the same end. Our attention has recently been drawn to other benefits besides safety to the traveller, which may be derived from a use of Mr. Kite's invention—we mean saving of time to the passenger, and of money to the railroad company. We have recently had some experience upon this point. On the Long Island railroad, over which we pass six times a week, a num-

ber of axles have been broken in the last six months—the cold weather of February was particularly fruitful in such accidents. On one of these occasions, the whole train was detained by the axle breaking under the tender; and before any advance could be made, the tender had to be removed and another furnished. The whole delay occupied about two hours. Now two hours for two hundred passengers, makes four hundred hours lost, or *forty days*, of ten working hours each—worth to a mere day laborer forty dollars, or enough to pay for the construction of a safety beam to every tender used on the road.

If Kite's safety beam had been used, *no delay* would have taken place, and *few, if any of the passengers would have ever known of the accident!* On several other occasions we have noticed, that the destruction of one axle involved that of several others, generally of all the wheels attached to them, and always of more or less of the track. Now the damage in each instance—leaving out of the account the injury to the cars and freight, sometimes a very serious one—would in no case be less than fifty dollars. We have thus the loss of forty or fifty dollars worth of time to the passengers, and of fifty dollars worth of damage to the company—always one or the other, and sometimes both at the same time—and all for want of this simple and economical preventive. These instances, we believe, are by no means rare on other roads; we only mention these as coming under our immediate observation. The company in question have, we understand, a few of these beams in use, and, so far as we have seen, no accident has ever happened to them; *they*, therefore, have an inducement to the employment of Mr. Kite's invention, which others have not.

Until something better can be devised, we shall continue to insist upon the necessity of employing Kite's safty beam.

For the American Railroad Journal, and Mechanics' Magazine.

NOTES ON PRACTICAL ENGINEERING.—NO. 1.

Cubical Quantities.

It is probable that all Engineers have, at different periods of their practice, devoted much time and attention to various methods of calculating cubical quantities. Innumerable tables have been formed and some few printed, but the writer is not aware that any tables of a general character have been published, except those of Mr. E. F. Johnson.

These tables give the cubic yards for 10 feet in length of pyramids, frustrums of pyramids and triangular prisms with slopes of $\frac{1}{2}$, 1, $1\frac{1}{2}$ and 2 to 1 when the depths at the ends are known. Also the cubic yards in rectangular prisms 10 feet wide, and, as in the other solids, 10 feet long. The calculations are made for depths from ·2 to 54 feet, the common difference being ·2 and the column of depths headed D+d represents the sum of the depths at the two ends.

D+d	Pyramids.				Frustrums of Pyramids.																Triangular Prisms.				Rectangular Prisms 10 feet breadth.
	d=o				d=·1(D+d) D=·9(D+d)				d=·2(D+d) D=·8(D+d)				d=·3(D+d) D=·7(D+d)				d=·4(D+d) D=·6(D+d)				D=d				
	b=½D	b=D	b=1½D	b=2D	b=½D	b=D	b=1½D	b=2D	b=½D	b=D	b=1½D	b=2D	b=½D	b=D	b=1½D	b=2D	b=½D	b=D	b=1½D	b=2D	b=½D	b=D	b=1½D	b=2D	
Feet.	c.yds.	c.yds.	c. yds.	c. yds.	c.yds.	c.yds.	c.yds.	c. yds.	c.yds.	c.yds.	c.yds.	c. yds.	c.yds.	c.yds.	c.yds.	c. yds.	c.yds.	c.yds.	c.yds.	c. yds.	c.yds.	c.yds.	c.yds.	c. yds.	c. yds.
10·0	3·09	6·17	9·26	12·35	2·81	5·61	8·42	11·23	2·59	5·18	7·77	10·36	2·44	4·87	7·31	9·75	2·34	4·69	7·03	9·37	2·31	4·63	6·94	9·25	18·52
10·2	3·21	6·42	9·63	12·84	2·92	5·84	8·76	11·68	2·69	5·40	8·09	10·78	2·54	5·07	7·61	10·15	2·44	4·88	7·32	9·76	2·41	4·81	7·22	9·63	18·89
10·4	3·34	6·67	10·01	13·35	3·04	6·07	9·11	12·15	2·80	5·61	8·41	11·21	2·64	5·27	7·91	10·55	2·54	5·07	7·61	10·15	2·50	5·01	7·51	10·01	19·26
10·6	3·47	6·93	10·40	13·87	3·15	6·31	9·46	12·61	2·91	5·82	8·73	11·64	2·74	5·47	8·21	10·95	2·63	5·27	7·90	10·53	2·60	5·20	7·80	10·40	19·63
10·8	3·60	7·20	10·80	14·40	3·28	6·55	9·83	13·11	3·02	6·05	9·07	12·09	2·84	5·69	8·53	11·37	2·74	5·47	8·21	10·95	2·70	5·40	8·10	10·80	20·00

The slope and depth are the only data required to calculate the cubic contents of the pyramids and prisms. But with the frustrums the case is different, for the ratio of the depths is here an element and, in the tables under consideration, four different ratios of D to d are given. Intermediate ratios may be closely approximated by a proportion, but as this is troublesome and as frustrums are the solids generally met with, the writer would suggest the use of an auxiliary table, (I,) calculated in the following manner.

It is shown by Mr. S. Hughes, in the Civil Engineer and Architects Journal, 1840, p. 335, that the content calculated from the mean depth or $\frac{1}{2}$(D+d) is less than the true quantity by $\frac{1}{12}(D-d)^2 r$, [r being the ratio of base to height] and that the quantity determined by averaging the end areas exceeds the true content by $\frac{1}{6}(D-d)^2 r$, the deficiency of the former being half the excess of the latter. Now, the mean depth or $\frac{1}{2}$(D+d) is equivalent to taking D=d, giving of course a triangular prism, hence, taking D+d from the column of triangular prisms with the proper slope and simply adding $\frac{1}{12}(D-d)^2 r$, from a table very easily formed, we have the true content. This is almost as quickly done as to determine the ratio and take the corresponding quantity from the column of frustrums, and when the ratio is not found in the table it will save some trouble. Table I gives the correction to be added to the content due to the mean depth for different values of D—d from **1** to **10** feet [for each tenth of a foot] in cubic yards per **100** feet with a slope of 1½ to 1. It may be carried as far as required by the method of second differences and the quantities vary directly as the slope or as r.

TABLE I.

$\frac{1}{12}(D-d)^2 \times 1\cdot5 \times \frac{100}{27}$.

D—d	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
1	0·46	·56	·66	·78	·91	1·0	1·2	1·3	1·5	1·7
2	1·85	2·0	2·2	2·4	2·6	2·8	3·1	3·3	3·6	3·9
3	4·17	4·4	4·7	5·0	5·4	5·7	6·0	6·3	6·7	7·1
4	7·41	7·8	8·2	8·6	9·0	9·4	9·8	10·3	10·7	11·2
5	11·58	12·1	12·5	13·0	13·6	14·1	14·6	15·2	15·7	16·1
6	16·67	17·2	17·8	18·4	19·0	19·7	20·3	20·9	21·6	22·1
7	22·68	23·4	24·1	24·7	25·4	26·2	26·9	27·7	28·4	29·1
8	29·63	30·4	31·2	31·9	32·7	33·6	34·4	35·2	36·1	36·8
9	37·96	38·8	39·7	40·6	41·5	41·8	42·5	43·4	44·3	45·3
10	46·29									

Mr. Hughes' investigations led him to conclude that little aid could be derived from the use of tables, though he refers exclusively to even cutting. Take, for example, the following: width of base 20 feet, slope $1\frac{1}{2}$ to 1, heights or depths 6 and 4 feet, length 100 feet; required the cubic content. From a table of even cutting or embankment we find $\frac{1}{2}(D+d)=5$ feet $=$ 509·2 c. yds. per ch. and adding the correction for $D-d=2$ feet $=1\cdot8$ per table I, we have $509\cdot2+1\cdot8$ 511·0 c. yds. the true content. Or, if we take the average of the quantities due to depths of 6 and 4 feet, we have $\frac{1}{2}(644\cdot4+385\cdot1)=514\cdot7$ and deducting (twice the quantity in table I due to $D-d=2=$)3·7 we have, as before, 511 c. yds. per ch.

Mr. Hughes prefers calculating each area; but it is only fair to observe that he takes a quarter of a mile at a time when the ground slopes evenly, whereas the custom in this conntry is, to take a level every chain for the roughest estimates, which of course renders the correction for longitudinal slopes less important. He does not even allude to the transverse slope.

Since reading Mr. Hughes' paper, the writer has seen in manuscript these same formulæ accompanying very extensive tables for different bases, slopes and depths, taking also into account the transverse slope, which is in fact the great difficulty. These tables were made by Mr. Lewis of Philadelphia; they are preceded by a thorough investigation into and complete demonstrations of the accuracy of the principles on which they are formed and have been partially in use for many years. The corrections for the longitudinal slope in even cutting are taken from tables similar to table I in this paper, and the effects of the transverse slopes are determined in a manner entirely different from that adopted by Mr. Johnson. But, as Mr. Lewis' treatise and tables have not been published, the writer does not feel at liberty to state more, than these and those of Mr. Johnson are the only papers in which he has seen a general as well as scientific examination into the measurement of cubical quantities for canals, railways, etc., with the requisite tables for practice.

When the ground slopes transversely it becomes necessary to cut it up into the solids at the heads of the columns of Mr. Johnson's tables in the ac-

companying extract.* The central or rectangular portions may be, in all cases, taken from tables so easily formed as to require no illustration or they may be calculated with great rapidity from the column of "Rectangular Prisms." When the ratios of D to d in the side pieces are not to be found in the table then the quantity opposite D+d may be taken from the column of "Triangular Prisms," and half the correction due to D—d in table I being added, the sum will give the correct content. Half the correction only is added, because table I is calculated for both sides.

Suppose $D=6$ and $d=4$, slopes $1\frac{1}{2}$ to 1 then, the ratio being in the table we find at once the content for one side piece or frustrum $=70{\cdot}3$ c. yds. per 100 feet. But if $D=6{\cdot}4$ and $d=3{\cdot}6$ then take D+d from the column of prisms $=69{\cdot}4$ and add from table I, $\frac{1}{2}(D-d)=1{\cdot}8$ c. yds. and we have $69{\cdot}4+1{\cdot}8=71{\cdot}2$ c. yds. per ch., the true content.

In this case D and d represent the *mean* depths at the ends, and another correction is required for the transverse slope, which is explained at length by Mr. Johnson, to which the writer has nothing to add, the only modification he has ventured to suggest being the additional table to give the contents of frustrums of pyramids by means of the difference in place of the ratio of their depths. In another number some views will be offered on approximate methods for preliminary surveys.

New York, July, 1843. W. R. C.

The pressure of other matter has compelled us to defer to the present number the conclusion of the excellent article on iron manufacture. It should have appeared in the last number, but its interest will not have suffered by the delay.

PRACTICAL REMARKS ON BLAST FURNACES.—BY GEORGE THOMPSON, ESQ., MINING ENGINEER.

[Continued from page 204.]

These general facts seem to contradict the opinion, that the whole *rationale* of the effect of the hot blast is merely a decrease in the density of the blast, because, with the inferior material, which requires with *cold* blast the *greatest* density, the *hot* blast has the greatest and *best effect.*

Those who are acquainted with cold blast working, know that most materials work best with what is technically called a "snuff" at the tweres; and to form this it is usual to blow a few inches below the surface of the scoria, which floats on the iron in the hearth. The "snuff" is a kind of arched tube formed by the cinder at the end of twere in the inside of furnace, and through which the blast passes. Now it appears to me that this natural muzzle of cinder has a great deal to do in diffusing the blast in contact with the material; and, mark that those materials which, from inferiority, required blast of the greatest density, gave the greatest trouble at the tweres, and presented practical difficulties in the "snuffing," which required a great pressure mechanically to overcome, and clear away for the passage of the blast upwards; for *such* materials, from what cause I know not, always work with great uncertainty at the tweres—sometimes having a tendency to stop up entirely, at others not snuffing at all.

If this practical difficulty could be avoided, perhaps the bad material might give a better result with a soft blast than we found it to do.

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* See page 269.

As regards the blast's density, when used hot, it must of necessity be much less than cold; for the quantity of air injected from the blowing apparatus is, generally speaking, no more with hot blast than with cold, while the area of the nose-pipes, taken together, is doubled or trebled. The diffusion of the blast by increasing the number of nose-pipes, and disposing them around the hearth, has produced great increase in make; and in some cases by this, together with increased shape, coals have been brought to work raw which with the first hot blast trials, could only be used when coked.

It seems agreed on all hands, the greater the number of the tweres around the hearth the better: and as I am aware that practical difficulties occur in doing so by the furnace "blowing forward," I will state a simple plan by which we overcame the difficulty. In building our furnace we had a round base as is now common, but instead of the usual four openings, we made five, one for the opening of the hearth, and *four for tweres.* By this method the blast from one twere does not blow against the other, and neither of them blow directly to the fore part; thus *eight tweres* may be used, two at each twere side.

More pressure is required even with hot blast to work some materials than others. For instance, we required but 2 1-2 lbs. per inch in North Staffordshire when working coke, but with coal, 3 lbs. per inch, with much greater heating surface, was required. The quantity of blast required here was very great. Blowing at four sides, we injected into a furnace fully 3000 cubic feet of air per minute, and heated to a high temperature. If this pressure happened at any time to be reduced, the effect was immediately perceptible, or if one of the tweres was taken off, a falling off in quantity and yield was the immediate consequence. The materials were, as I have before noticed, the worst I ever saw; both coals and ironstone being sulphury.

I will give only one other fact, a very extraordinary one, showing a most peculiar effect produced by a *simple increase of temperature*, at a work near Tipton, where the materials are of fair quality. The furnace upon which the experiment was made is only 11 1-2 feet at "bosh," and 45 feet high, worked with raw coal and hot blast; it produced 100 tons a week, being blown with five tweres, of 3 inches diameter each.

The cross pipes of the heating apparatus were four inches diameter, and one apparatus supplied all the tweres.

The alteration was this, the number of heating pipes was increased, the cross pipes increased in size from 4 inches diameter to 7 inches diameter, and the main pipes also enlarged; the top of the furnace widened from 4 feet diameter to 7 feet diameter; the number of tweres increased from five to six, two on each side and two at back, each of 3 1-2 inches diameter; a new steam cylinder of greater power was put to the blast engine, but the blast one was kept at the same size.

The consequence is, that more than 150 tons of iron have been produced at this furnace in one week, with an improvement of yield, and the *engine goes no more strokes*, showing that actually no more *air* is forced into the furnace than when making only 100 tons a week, two-thirds of present quantity, although with a much greater area of nozzles.

I give a short table of the pressure of blast, which shows that the quantity of blast bears no constant proportion to the capacity of furnace nor to the make. The results given from the Glasgow furnaces are taken from data by M. Dufrenoy in 1833, but since that period, the areas of nose pipes, and the number, and consequently make, have been increased as at other places.

This table shows that the quantity of blast varies with different material

to produce the same quantity of iron, especially with cold blast, with hot blast the *areas* bear little relation to the actual quantity of air injected, which cannot be arrived at without the capacity of the blowing cylinder and speed of engines.

TABLE No. II.

COLD BLAST.				
	Pressure in pounds.	Total area of nose pipes in circular inches.	Capacity of furnace, cubic feet.	Weekly make of iron.
Works near Glasgow,	3	12·5	2500	45 Tons.
Lightmoor works with *bad* material,	3	15	2000	45 "
Same, with *good* material,	$2\frac{1}{2}$	12·5		65 "
Fenton Park, with *bad* material,	$2\frac{1}{2}$	12·5	1000	25 "
Corbyns Hall, Mr. Gibbons, *good* material.	2	18·2	4000	115 "

HOT BLAST.				
	Pressure in pounds.	Total area of nose pipes in circular inches.	Capacity of furnace, cubic feet.	Weekly make of iron.
Works near Glasgow,	$2\frac{1}{4}$	18	2500	60 Tons.
Fenton Park works,	$2\frac{1}{2}$	27	1000	40 "
The same, with different shape of furnace,	3	36	2500	70 "
Tipton, a work at,	$2\frac{1}{4}$	45	2200	100 "
The same, with increased heating surface, but no greater *quantity* of blast.	$2\frac{1}{4}$	72	2600	150 "

The tables and statements are much more general than I could have wished; at the same time I think they sufficiently show that, 1st, there is a remarkable difference in the material of different strata in the same coal fields; 2d, that modifications of shape and alteration of capacity have a very considerable effect; and 3d, that the effect of blast is very various with different materials; that an alteration of its temperature, with certain coals, produces a saving of, in some cases one-half, in others two-thirds of the quantity, while with other coals the difference is scarcely perceptible, and the quantity of blast has little relation to the quantity or bulk of material acted upon.

The improvements in iron smelting have been effected simply by the observation and consequent successive trials of practical men; they have been the result of no principle previously established, no theory obtained from the laboratory of the chemist: and further, I think it cannot be denied that the anomalies apparent under each condition into which I have divided my results, present a problem which, as far as chemical analysis has yet gone, it is difficult to solve. And it must surely be admitted that, had these conditions been previously laid down to any one well acquainted, theoretically or practically, or both, with the manufacture of iron, together with a careful analysis of the material here referred to, he would never have predicated such results as have in reality accrued.

That the want of a guiding principle is greatly felt, and its attainment greatly to be desired, needs not to be set forth; and as there is no effect

without a cause, I do not see that the number of apparent contradictions in these ought to make us in the least despair of ultimately attaining, by the powerful aid of science, a satisfactory rationale of the whole case. This, however, will never be done by avoiding the question, by taking a partial view of facts.

READING RAILROAD AND THE COAL TRADE.

In our last number this road was referred to for the purpose of showing the economy which will result to the consumers of anthracite coal, from its ability to reduce the cost of transportation. More than three-fifths of the cost of our coal in New York, is paid for transportation and other expenses after it leaves the mines. Consequently, as the facilities for transportation, and handling the coal after it leaves the mines, are increased, so will the cost be reduced to the consumer.

The average cost of transportation by the Schuylkill Navigation company for the years 1835, 6, 7, and 8, was, *freight* $1 28 and *toll* 92 cents, or $2 20 per ton, exclusive we believe, of the cost of trans-shipment from *boats* to *vessels* at Philadelphia; whereas, it is now only 70 cents freight and 54 cents toll, or $1 24 per ton exclusive of cost of trans-shipment as above, thus showing conclusively what has been effected by the completion of the Reading and Pottsville railroad, and enabling us to draw tolerably correct inferences as to its future advantages to the consumers of coal, to say nothing of its utility to the travelling community and to the cultivators of the soil in the beautiful and fertile valley through which it is located.

This road may, we think, be considered a model road for a heavy business in one direction. Its grade is unequalled on a road of its length, either in this country or Europe, and its curves exceedingly favorable, for a heavy trade. There is no curve, we believe, with a radius of less than a thousand feet. The road-bed is graded the entire distance for a double track, though but a single track is laid, except at suitable places for passing the trains, and the distance of about 18 miles between Reading and Pottstown, where a second track is now nearly completed, which will greatly increase the capacity of the road for the coal business.

The superstructure is of a permanent, yet very simple character, consisting of the T rail, as it is called, of 56 lbs. to the yard, laid on cross sills of oak, 8×12 inches; resting on broken stone well rammed, in trenches.

The facilities at Mount Carbon for collecting the coal, appear well arranged; the cars of the company which are uniform in size and appearance and made to contain each 3½ tons, are taken by the coliers to the mines, loaded and returned to the depot, where each car is weighed and then arranged in trains on the side track ready for departure. The company have now about 26 to 28 locomotives, eight being light for passengers and common freight, and the others heavy for coal; 14 passenger cars, mostly on 8 wheels; 175 freight, and 1600 coal cars, the latter are to be gradually increased to 2500, and the engines to 32 or more as may be requisite.

The arrangements for an extensive business on this road appear well

made; but with no part were we better satisfied than with the depot at its termination at Richmond, about three miles north of Market street, where the company own 45 acres of land, fronting 2200 feet on the river, a part only of which is yet improved. Here the company have seven piers, nearly completed, where 12 to 15 vessels may be loaded at the same time, and with a facility truly astonishing. These piers are built of truss work, 10 or 12 feet above high tide, with tracks laid to their extreme ends, with openings in the floor between the rails, and slides or shutes beneath, by means of which, the coal, when discharged through a trap door in the bottom of the car, is carried directly into the hold or on to the deck of the vessel along side, and so complete are the arrangements that when the car is brought to the proper place, the load can be discharged *into the vessel* in one minute, and a vessel of 200 tons loaded in a few hours, and under sail for the port of her destination the same day; and thus the coal by the *railroad* may often be unloading at the wharves in New York, while coal shipped same day by canal at Pottsville, is being trans-shipped at Philadelphia.

The freight on coal is certainly as low as it can be afforded. The fare for passengers was, we thought, too high, $3 50 for 96 miles—and we so intimated to the gentlemen in charge. We closed our article on this road, in the August number by refering to the *rates of fare*, and we promised to give them a word of advice in our next, but are happy to be able to say that the gentlemen who manage the Reading railroad have consulted better counsellors than we claim to be—their own good judgment—and their interest, and reduced their rates, as we learn from the Miners' Journal of Pottsville, for *through* passengers, from $3 50 to $2 50; and the result will, we doubt not, at least we *hope* it may be, a handsome increase of receipts for the ensuing year.

The entire amount of coal transported on the railroad last year, was 54,000 tons; this year to 25th July, 81,000 tons, and the company now run eight daily trains of 50 to 60 cars each. But they have *not yet fairly commenced* operations. It will require about three years to get thoroughly organized and in possession of the business, and then they will *average* about fifteen trains per day, of 150 tons each, for 10 months in the year.

GOVERNMENT AID TO RAILWAYS.

The following letter was addressed, by request, to the President of the New York and Albany railroad company, and by him transmitted to the heads of the War and Post Office departments at Washington. It was published by order of Congress. See No. 327 senate documents, 27th congress 2d session. The great importance of the subject will be deemed a sufficient excuse for its republication in the columns of the Journal.

Dear Sir: In accordance with your request, I give you my views on the subject of aid to railways by the general government. This aid, if rendered, will probably be given for the following reasons:

1. The great importance and value of railways in contributing to the defence of the country.

2. The facilities they afford for the speedy and cheap transportation of the mails.

I have long been of the opinion that the railway system, when perfected, would be found in time of war one of the most efficient means of defence.

For the rapid transportation of troops and munitions, etc., at all seasons railways are unrivalled by any other mode of communication. It is fortunate that, excelling as they do in this respect, they are, if anything, superior to other modes of artificial communication for commercial purposes. It is fortunate, also, that railways judiciously located, with a view to the latter object, connecting the larger cities by routes passing in a direction where the population is the most dense, and where, in general, the ground is the most favorable, are in the best positions for collecting the military force of the country, and concentrating it upon those points which are most important to be defended.

In all military operations celerity of movement is of the utmost importance. The history of modern warfare is indeed conclusive in this respect. With the means of quick conveyance afforded by railways, an army of a given number of men may be rendered as effective as one composed of double or treble that number deprived of those facilities, and the forces of the country may be so rapidly concentrated at any exposed point as to enable us, at short notice, to arrest the advance of an invading enemy before he shall have made a lodgment on our soil, or effected any serious injury. The citizen-soldier, who, in time of war, is to-day cultivating his fields in the interior of our own State, [New York,] may to-morrow be found battling with the enemy on the banks of the Niagara, or resisting his approach to the shores of New England.

The extent of railways already constructed and in operation in the United States amounting, in the aggregate, to upward of *three thousand* miles, together with the great extent of steam navigation on our inland lakes and rivers, places us, as it regards our ability to repel invasion, in a condition far superior to that in which we were found during the last war with Great Britain. Then there was almost a total want of all suitable means of internal communication, and, in consequence, the land operations were conducted in a comparatively feeble and inefficient manner. Now, with the means at command, and which, under suitable encouragement, will be yearly increasing, through the extension of the railway system, together with the rapid increase in the population and improvements in the arts and the defences of the country, we are, or soon will be, in a condition which will render us secure, as it regards serious injury, from the attacks of any foreign enemy.

Of the railways constructed and in operation in the United States, a very large majority have been built by private means under acts of incorporation from the several States. In some instances they have been constructed by the States; but the ill success thus far of this mode, combined with the evils of a political character inseparable from it, its expense, and the evident impropriety of making the States the common carriers of the produce of the country, renders it probable that but few railroads will hereafter be constructed as State works.

Works of this description will, it is presumed, be mostly undertaken, as heretofore, by private companies, and it is with them that arrangements must be made, if they are to be used for the purposes of the Government in the conveyance of troops and munitions of war and the transmission of the

mails. Experience has shown that the railway system, to become sufficiently general, requires the fostering aid of the government.

While the country was unusually prosperous, and confidence was firm in the success of improvements of this description, capitalists were willing to invest their funds in them. Circumstances are now different, and the aid of the government seems to be indispensable to cause the system to advance at a rate suited to the growing population and wants of the country.

The very limited aid which the general government has hitherto given to railways, by remitting the duties upon iron used in their construction, has been of great service. This aid was granted without any understanding with the companies as to the conditions on which the roads, when completed, should be placed at the service of the government. In consequence of which, the government has been, in many instances, compelled either to pay very extravagant prices, or forego the advantages which railways offer for rapid transportation in the conveyance of the mails, and for other purposes.

This should not be, and the government, in giving further aid, should secure to itself the use of the railroads upon the most equitable terms. This is the more necessary, inasmuch as it is desirable to reduce the rates of postage, particularly upon letters, which are now exorbitantly high, and, of course, to lessen as far as possible the cost of transportation of the mails.

Congress, at its last extra session, amended, or rather altered, the law relating to duties on railroad iron, so as to preclude the companies which had not then commenced the construction of their roads from benefiting by the remission of duties on that article. Should legislation stop here, great injustice will result. Of the railways in operation in the United States the majority are confined to particular States or sections of the Union. In several of the States and Territories no railroads have been constructed, and in others improvements of this description have but just been commenced. There seems, therefore, to exist a necessity founded on principles of equity that the aid of the general government should be continued to new works in the same proportion as hitherto—if not by the same mode of a release of the duties on railroad iron, by an equivalent thereto in money.

The aid thus given will fall far short of the benefits to be derived to the country from having a perfect system of railway communication constructed and ready for use on reasonable terms. I would therefore propose, with a view of giving the requisite encouragement to the prosecution of new works, and of securing for the use of the government, on reasonable terms, those already in operation, that *further* aid be rendered as follows, viz:

All lines of railway completed and ready for use of not less than fifteen miles in extent to be entitled to a fixed sum per mile, say *twenty-five hundred dollars.*

In consideration of the aid thus given, the several companies to bind themselves—

1. To convey the government mails as often as twice each day in opposite directions over the whole extent, or any portion of their respective roads, at a speed of not less than seventeen miles per hour, at the following rates of compensation:

For every mail weighing two hundred pounds or less, ten cents per mile.
For each one hundred pounds additional one cent per mile.

2. Each mail to be accompanied, if required, with a deputy postmaster or attendant, for whose conveyance no charge is to be made; and at all points on the line where mails are to be exchanged sufficient time to be allowed for the purpose.

3. If the mail is required to pass four times daily over any road, twice in

the same direction, tnen, for this additional service, the rates to be the same as above, unless a locomotive is run especially for the purpose, in which case the compensation to be fixed by three disinterested persons, which compensation shall not exceed treble the rates above stated.

4. For the conveyance of ordnance and military and naval stores of every description for the general and state governments, per ton per mile, two cents.

5. If the amount of ordnance and military or naval stores conveyed as above at any one time by a locomotive expressly detached for the purpose is less than fifty tons, the rate to be one dollar per mile for the whole load. If over fifty tons, the rate not to exceed two cents per ton per mile.

6. For conveying each person attached either to the regular army, the militia, or the navy, below the grade of commissioned officers, when in service, either in peace or war, one cent per mile.

These conditions should be binding, not only upon the railway companies, but upon their successors owning the roads.

The several prices or amounts stated may not be the best or most judicious in each case, but it is believed that the outlines of the plan are such as will prove most equitable to the companies, and economical and effective to the government.

The plan which has been suggested of paying to each railway company a gross sum in advance for the transportation of the mails during the existence of their respective charters, is objectionable, as it tends to inequality and injustice in the compensation to different companies, and will require to effect it a greater present outlay of funds than it may be convenient for the government to furnish. It is objectionable, also, in consequence of the difficulty of anticipating the future wants of the government, and ability of the companies to fulfil their engagements.

The causes which have hitherto produced a rapid improvement of the country, are still in existence, and will under a restoration of confidence, which is sure to take place, continue to produce its legitimate effects, rendering it impossible to predict the changes which even a few years may produce.

New and more direct thoroughfares may be opened, causing an entire change both in the weight and periods of transmission of the mails. Where now the mails are lightly burdened, the weight may be found greatly to increase, and the intervals of their transmission lessened, and the reverse.

The companies having received compensation in full in advance will have no suffieient inducement to fulfil faithfully and promptly in all cases their agreements, even if they have the ability to do so, and may be disposed to embarrass as much as possible, without violating the strict letter of their contracts, the operations of the post office department for the purpose of securing additional and exorbitant compensation.

By this plan also, the government is placed at the mercy of the railway companies, as it regards the use of their roads for military purposes, thus depriving itself of one of the greatest advantages to be derived from contributing its aid to the construction of railways.

The two objects of military defence and the conveyance of the mails should not, I think, be separated in legislating upon this subject.

The public welfare is intimately connected with both, and they are both, it is believed, clearly within the constitutional powers of congress to foster and promote in the manner above described. Railways at the present day are indeed *indispensable* for both purposes.

The amount of two thousand five hundred dollars per mile may be great-

er than is necessary to place these works at the service of the government, but even that will not amount to a large sum in the aggregate.

The total extent of railway now in operation in the United States is about *three thousand* miles, which, at two thousand five hundred dollars per mile, is *seven and a half millions* of dollars, a sum small in comparison with the advantages the country will derive from being able to avail itself in case of war, and for the other purposes mentioned, of the roads now in use, even if there should no stipulations be entered into, as to the terms on which transportation for the government is to be conducted.

The very great utility and importance of railways in a military view, do not seem to have been, as yet, fully appreciated.

All those sea ports which have these communications with the interior, possess resources and means of defence of almost incalculable value.

Among the most favored of their number is the city of Boston. From that city five lines of raliway radiate in as many different directions into New England, and one of them after traversing the length of Massachusetts, enters the State of New York, and connects at Albany with the lines of railway extending west and north of that city.

By means of these railways the city of Boston is enabled to command within two to four days' notice, at all seasons of the year, the whole disposable force spread over New England, and northern and western New York. The grand depot of the government arms and munitions for the northern section of the Union at Watervliet on the Hudson river, is now brought within twelve hours of Boston. Thus situated, the city of Boston possesses resources and a degree strength to resist invasion which is not possessed by New York. The latter city, unlike every other leading city on the Atlantic seaboard, has no direct railway communication with the interior of the country. In winter she is cut off except by a circuitous route through other States, and the exposed navigation of Long Island sound, from all access to the great military depot, at Watervliet, above mentioned, and from the aid which, in case of an attack, would instantly rally to her defence, from the west, the north, and the east.

The construction of the New York and Albany railroad will supply to New York city, more than any other work of internal improvement, the means of defence, giving her all the advantages in this respect possessed by Boston.

The proportion of government aid which would fall to this work, at the rate above proposed of two thousand five hundred per mile, will be three hundred and seventy-five thousand dollars, a sum not greater than the cost of one of the steam frigates recently constructed,* and not requiring like them, the *additional expenditure of large sums annually*, to maintain and preserve in a condition for use.

Of the great value of the railway in its ability to contribute to the defence of the city, there can be no doubt. If constructed and operated in the best manner, with a branch connecting with the eastern roads, the force of men and ordnance which might be brought to New York, at short notice, could not, from its magnitude, be easily computed.

By an attentive consideration of the subject, we shall not fail to discover in the railway system, the elements of great strength in a military view, so essential to our independence and safety, the importance of which is so often

* The steam frigates referred to are the Missouri and Mississippi. The cost of the former, as since ascertained is $566,458·28, and of the latter, is $553,759·93! This is exclusive of the large amount recently expended in abortive attempts to dispense with the chimney or smoke pipe in the former vessel.

lost sight of, so easy is it in times of peace to forget that wars have been, and that the feelings and passions of mankind have in no wise materially changed.

To those who view with regret the necessity which exists of expending large sums in the erection and maintenance of the defences of the country, to enable us to resist encroachments upon our rights from abroad, it will be gratifying to know, that the government in giving its aid to railways for the purposes mentioned, is at the same time promoting in the most effectual manner a system of improvements, which, more than any other, is calculated to contribute to the prosperity of the country in a commercial view, developing more completely its resources, facilitating the early transmission and diffusion of intelligence, and uniting with stronger bonds the different sections of the Union.

EDWIN F. JOHNSON,
Chief Engineer New York and Albany Railroad.
New York, April 9, 1842.

GREAT PERFORMANCE OF A LOCOMOTIVE STEAM ENGINE.

The following statement appeared in the United States (Philadelphia) Gazette, sometime since, but its re-publication in the Journal has been delayed in the expectation of receiving further particulars, in relation to the engine from the manufacturers. They have, however, been so occupied that they have not been able to furnish the desired description; we therefore now give Mr. Campbell's account of the performance on the Columbia road, and think we may promise our readers something further of interest from the same manufactory at an early day, as Messrs. Baldwin and Whitney have made an engine for the Western railroad, which is soon to be tested on its heavy grades, and, from what we learned on a recent visit to their manufactory, we anticipate very favorable results.

We would say, in addition to Mr. Campbell's report that the engine referred to by him, as we are assured by an intelligent friend who witnessed its performance, turned a curve of 90 feet radius repeatedly without any difficulty.

Mr. Editor—Messrs. Baldwin and Whitney, engineers of this city, have recently made and patented valuable improvements in their locomotive steam engines, by which the weight upon each pair of wheels is equalized, the facilities for turning curves and conforming to the undulations of the rails increased, and the efficiency for carrying freight, in proportion to the aggregate weight and cost of the engine, nearly doubled as compared with engines of ordinary construction. One of these engines, on six wheels, all of which are connected, was recently finished and placed on the "Philadelphia and Columbia railroad" for trial, where its performance fully realized the expectations of the makers.

The weight of this engine, in running order, including two men, water, and fuel, is 28,500 lbs. or 12 $\frac{72}{100}$ gross tons. The weight of the tender with a full supply of fuel and water, is 25,275 lbs. or 11 $\frac{28}{100}$ gross tons.

The undersigned feeling an interest in all improvements of so much importance to the public, and in the success and economy of railroad transportation, made several trips upon this engine, across the Columbia railroad, in company with Mr. Whitney, one of the builders, with a view of testing its merits. Upon these several occasions, its performance was as follows:

On the 17th of the present month, it drew from the station at the head of the Schuylkill plane, to Columbia, 32 loaded cars, including a three section portable boat, weighing altogether 165 tons 5 cwt., 2 qrs. 13 lbs. exclusive of engine and tender, in 8 hours 30 minutes, running time, distance 78 miles.

On the 18th it returned from Columbia, drawing 40 loaded cars, weighing exclusive of engine and tender, 204 tons, 13 cwt. 2 qrs. 14 lbs. in 8 hours 45 minutes, distance same as before, 78 miles.

On the 22d a full train westward, could not be obtained. The engine started from the Schuylkill station with 20 loaded cars, which were increased at the stations along the line, to 40 cars, generally without cargoes, the engine at no time drawing over 110 tons, exclusive of its own weight and tender.

On the 23d it left Columbia with 47 loaded cars weighing 249 tons, 19 cwt. 3 qrs. 13 lbs., which it drew up all the grades upon the road, to 39 feet rise per mile. It drew 39 of these cars, (including a three section portable boat) weighing 233 tons, up grades 45 feet per mile, time of running 78 miles, 9 hours 18 minutes.

On the 18th the engine evaporated 499½ cubic feet of water, accurately measured, and consumed $2\frac{25}{100}$ cords of dry oak wood, and 40 bushels of bituminous coal. On the 23d it evaporated 519 cubic feet of water, and consumed $2\frac{34}{100}$ cords of dry oak wood, and 40 bushels bituminous coal. The wood was of good quality, but the coal was unsuitable. It was very fine, and large quantities of it was carried out with the blast from the exhaust steam pipes unconsumed.

Besides the resistance resulting with the *friction* of cars or wagons of a train, an additional resistance occurs from the *gravity* of the whole mass upon the plane. That gravity is the force by virtue of which the train would descend the plane if not resisted, and is equal to the weight of the mass divided by the number that indicates the inclination of the plane.

If therefore, in the case of the ascent of a grade of 45 feet per mile which is one foot in 117½ on the 17th with a train of 165 tons, 5 cwt. 2 qrs. 13 lbs. and the engine and tender weighing 24 tons, the total weight of the mass would be, 189 tons, 5 cwt. 2 qrs. 13 lbs., which divided by 117½ gives the gravity 3613 lbs., which added to the resistance from friction of the cars at 8 lbs. per ton or 1320 lbs. gives a total resistance of 4933 lbs. overcome by the engine, (exclusive of the friction of the engine itself) which on a level railroad, is equal to a train of 616 tons.

On the 18th the resistance overcome by the engine on 45 feet grades was 5997 lbs. which was equal to 749 tons on a level railroad.

On the 23d the resistance from gravity and friction, on 39 feet grades, was 6532 lbs., which was equal to 816 tons on a level railroad. Or in other words the power of the engine exerted horizontally on the rails, would have lifted a weight perpendicularly, if attached to a rope working over a pulley, of 6532 pounds.

The above performances are greater by far, than those of any other engine of the same aggregate weight, known to the undersigned. The improvement is of great value, and really enhances the value of every railroad in the Union, having extensive sources of trade.

H. R. Campbell, C. E.

PROGRESS OF THE DOCTRINE OF LOW FARES.

It was not without quite an effort that this doctrine was adopted this season, on the Western railroad, from Worcester to Albany, but its friends finally prevailed, and the result is as we anticipated, a large increase of pas-

sengers, equal during the month of May to 79½ per cent. and during the month of June, to 105 over the corresponding months of 1842.

The Boston and Providence road also adopted the doctrine; the Paterson road followed, and now several of the southern roads *south* of Washington city, as we learn from a gentleman in Richmond Va., have adopted lower rates. He says that the fare is now only $20 from Washington to Charleston, S. C., while it is an *eighth* of that amount, or $2 50 from Baltimore to Washington—40 miles, or over six cents a mile on one of the greatest thoroughfares in the United States. This is a sad mistake as we understand the laws of trade, and will inevitably lead to an opposition line of stages which, though it may not be successful, will injure the railroad by exciting a spirit of hostility not only to that road, but also to the whole system for a time.

We would not have a company reduce their rates so as to injure the stockholders, or to prevent their receiving a fair income upon their investment; we know of no capitalists who are better entitled to liberal dividends than those who invest in works designed to facilitate communication between distant points, as they make neighbors and friends of strangers; and it is precisely on this account that we advocate a system which we believe has in nine cases out of ten, where adopted, tended directly to increase the receipts and dividends; and hence it is we desire to see the fare reduced between New York, Philadelphia, Baltimore and Washington city, on all of which roads the charges are exorbitantly high when compared with other railroads, and the travel over them.

The charge from New York to Philadelphia $4, Philadelphia to Baltimore $4, and from Baltimore to Washington $2 50, or $10 50 for 234 miles is, in *these* days, on *such* a route, entirely too high, and *must* come down.

It will be said perhaps, that the Camden and Amboy charge only $3 in the morning, to and from Philadelphia, and that by the way of Newcastle and Frenchtown only $2 is charged between Philadelphia and Baltimore; true, and it is because they can *afford* to carry passengers between New York and Philadelphia, and Philadelphia and Baltimore at lower rates and *do not*, only when *obliged* to, that we complain. Their own interest would, as we contend, be ultimately, if not immediately, promoted by adopting lower rates. Of this we have not a shadow of doubt, though we may be in error. We give the annexed, from the Boston Traveller, of 29th July, in support of our position, and shall look with much interest for the regular monthly reports from those roads which have adopted low fares.

Western Railroad.—A correspondent furnishes the following statement in relation to the low fare policy and its effects upon this road.

In March and April last, the expediency of reducing the rate of fare on this great line of communication was elaborately discussed in the public prints, and two tickets were run for directors, one of which was styled the low fare ticket. The election having resulted in the choice of a majority of the low fare party, the first and second class rates for through travellers

were reduced in April last from \$5 and \$3$\frac{1}{3}$, to \$4 and \$2$\frac{7}{10}$. The measure has been silently in progress for the last sixty days, and while little gain appears in the way travel as compared with the the corresponding months of last year, an increase of nearly *one hundred per cent.* occured in the number of through travellers, materially augmenting the revenue of the road, although a disproportionate share is paid to the Boston and Worcester railroad company who would not concur in the reduction.

Number of through passengers for May, 1843,	2659$\frac{1}{2}$
Number of through passengers for May, 1842,	1482$\frac{1}{2}$
Gain 79$\frac{1}{2}$ per cent.,	1177
Number of through passengers for June, 1843,	3813$\frac{1}{2}$
Number of through passengers for June, 1842,	1866
Gain 105 per cent.,	1947$\frac{1}{2}$
Aggregate for May and June, 1843,	6473
Aggregate for May and June, 1842,	3348$\frac{1}{2}$
Gain 90$\frac{1}{2}$ per cent.,	3125$\frac{1}{2}$

These passengers being way-billed, having no tickets, except for the first stage, and no privilege to stop on the line, except while the train stops, cannot convert their tickets into way tickets.

In addition to the great increase of numbers this measure has given (as predicted) an impulse to the freight, the through freight from Boston to Albany having been trebled in May and June last, as compared with the same months of the preceding year.

We are happy to learn the low fare is succeeding equally well with the way travel on the Worcester railroad, as evinced by the remarkable success of the special train at 2 cents and 1$\frac{1}{2}$ cents per mile, between Boston and Newton.

Since the above was written, we learn from the Miners' Journal, of 29th July, that the managers of the Philadelphia and Reading railroad have reduced the fare for through passengers from \$3 50 to \$2 50.

RAILROAD ACCIDENTS.

It is much easier to complain of accidents on railroads than to point out the means by which they may *always* be avoided, yet so frequent have they become of late, that it is well worth while to inquire whether some of them at least, are not the result of carelessness, or something less excusable.

But a short time since we cut the following from the Hartford Courant.

"The railroad cars, on Saturday afternoon, were an hour or two behind their usual time. The detention, we understand, was occasioned by a horse which ran along the track, in front of the engine, for several miles, and finally stumbled. The cars passed over him, crushing him of course. The baggage car was thrown from the track, and one of the other cars was somewhat injured. No other injury or loss was occasioned."

An engine-driver who would be guilty of thus jeoparding the lives of his passengers and at the same time of torturing so noble an animal as the horse, deserves instant dismission from employment in a position where he can gratify his mischievous propensities at so great a hazzard to others.

The ink was scarcely dry which recorded the above, when we read of an accident on the Baltimore and Ohio road, from a cow on the track. Fortunately, very little damage was done in this case; it will, however, be exceed-

ingly difficult to avoid a repetition of similar and perhaps fatal accidents on this road, with its numerous short curves, unless measures are adopted to keep cattle off from the track, which *must* be done.

The next on the list of railroad accidents was on the Utica and Schenectady road, which fortunately, was more disastrous to the company in the destruction of engines and cars than to the passengers, who, providentially, escaped without injury. There was not, it appears to us, in this case, due precaution used by the superintendant, in allowing the up train to start until the other train arrived. There should be a rule, invariable, never to send out one train, on a single track, when another is due. Such a rule if never deviated from would insure greater punctuality in starting, which is also important, and should be insisted on by travellers, or rather by the *directors* of the companies.

It was stated in some of the papers that the up passengers were not along —only a few empty cars—when the collision took place, but we have been informed by a gentleman who ought to know, as his wife was in one of the cars, that the passengers were along. The censure in this case should not fall wholly on the managers at Shenectady, but mainly on those at the western termination who disregarded their pledge to start at a given hour, to increase thier passengers, should be held responsible, and made to feel the full force of the public indignation. It is inexcusable thus to trifle with those who travel, and keep hundreds waiting for hours and then risk their lives, that a few more passengers may be taken to-day instead of to-morrow, or perhaps it would be as near the truth to say, be *kept from the packets.*

Another accident occurred on the Philadelphia and Wilmington railroad on Sunday night, 30th July, as it appears from a Baltimore paper, from sheer carelessness, that is, from sending out an extra train upon a single track road, before the other train had arrived. Fortunately, no passengers were injured, yet the engines were destroyed.

The last and sadest recent accident, of which we have now, Aug. 4th, any account, took place on the Reading railroad, and from the information before us, it appears to us, as the Philadelphia Forum says, is wholly attributed to "the carelessness of the agent," who should have detained the up train until the other train arrived.

There must be *system* and *order* and *punctuality* on a railroad with only a *single* track, to avoid accidents, and there should be a more thorough police, until a system of telegraphic signals shall be established, as we hope may soon be the case, on our main lines of railway.

RATES OF FREIGHT FROM ALBANY TO BOSTON, 200 MILES.

In *first* class cars, through, $7 per ton, or 3½ cents per ton per mile, for enumerated articles, and $4 per ton, or 2 cents per ton per mile, for other articles in *second* class cars. When in quantities of 6000 lbs. or over, and notice is given before hand that there will be as much as 6000 lbs, a deduction of 20 per cent. is made from the above rates, on certain specified articles.

Flour to Pittsfield, 27 cents; to Springfield, 33 cents; to Worcester, 34

cents, and to Boston 30 cents, it being less trouble to take it through than to leave it on the way.

Live stock, horses and horned cattle, not over four, by special contract. The same, over four, at first class rates. All other live stock will be charged, between

Greenbush and Brighton	$8	per	2000 lbs.
Pittsfield	"	7 "	"
Springfield	"	5 "	"

and in proportion from intermediate places.

Sheep and lambs are estimated at 100 and calves at 125 lbs.

Swine in quantities less than $3\frac{1}{2}$ tons, in one consignment, to be charged at $3\frac{1}{2}$ tons; live stock to be fed at the owners cost.

The above abstract, is from the rates established 10th April 1843, a copy of which, together with a copy of the rates for 1842 we request the gentlemen managing the road to forward us; and the managers of each road in the United States are requested to do likewise, that we may show a comparative statement.

GOVERNMENT AID TO RAILROADS.

An important document will be found in this number of the Journal in relation to national aid to railroads, with the view of securing to the government all the advantages of railroads for the transportation of the mails, troops and munitions of war, at low rates and stipulated uniform prices. The subject is one of vast and growing importance, and we consider the present period peculiarly appropriate for the United States government to consummate an arrangement with the numerous railroad companies now in successful operation, which shall be mutually advantageous to both parties and highly important to the government in time of war, for the transportation of men and munitions, and to the *people* at *all* times for the transportation of the mails.

Many companies would be more benefited by receiving a small bonus, which might enable them to liquidate present liabilities and put their road in more complete and efficient order, than by double the amount at a future period; and the government can with great ease accomplish the desired object by the issue of a five per cent. stock, redeemable 30 years hence, during which period the entire amount of the stock would be saved to the government in the reduced cost of transportation; and it would be no compliment to the sagacity of the gentlemen at the head of the different departments, requiring the use of railroads, to suppose they do not perceive that a much more favorable arrangement can now be made than at a later period, when the different companies shall have surmounted their difficulties and completed their roads.

WOODEN COUPLING BARS.

The advantages of this mode of connecting cars have long been known, and yet its use is, as far as we are aware, quite limited, as we have seen

wooden connections used on but few roads. The following is one of many instances that might easily be brought forward in favor of this simple and yet highly useful invention.

"We learn that the passenger cars in the Cumberland train which ran over a cow, on Wednesday night last, were connected to the wood car by *wooden coupling bars*, which broke when the engine went off the track, and the cars were thereby uninjured. This mode of connecting the passenger cars upon the Baltimore and Washington railroads has been in use for some years, and the superiority of the plan is made manifest whenever an accident similar to the above has occurred."—*Balt. Pat.*

CANAL TOLLS.

The following statement in relation to the canal tolls, is from the Albany Argus:

"Account of tolls received on all the canals of the State, during

	2d week in July.	Total to 14th July.
1839,	$32,784	$681,179
1840,	39,512	627,807
1841,	45,813	793,629
1842,	35,789	666,246
1843,	51,038	719,570

Account of flour and wheat arrived at tide water during

	2d week in July.		Total to 14th July.	
	Flour, barrels.	Wheat, bushels.	Flour, barrels.	Wheat, bushels.
1842,	30,154	7,059	481,865	176,757
1843,	72,344	15,242	558,931	147,421

Amount of tolls received at Albany on the Erie and Champlain canals:

	1842.		1843.	
April,	$14,326 07			
May,	46,766 43		60,646 27	
June,	23,688 27		26,311 47	
July,	23,292 13	—98,072 90	25,249 47	—112,207 21
				98,072 90
Increase to 31st July,				$14,124 31

Account of tolls received on all the canals of this State, and of the lockages at Alexander's lock, three miles west of Schenectady, to the 1st Aug.:

	Tolls.	Passages at Alexander's lock.
1839,	$761,423	10,646
1840,	716,526	11,555
1841,	912,224	13,486
1842,	750,951	10,090
1843,	858,485	9,668

The increase over last year is		$109,534
Of this increase there is at Buffalo	68,459	
" " West Troy	28,424	
" " Albany	6,368	—103,251
Leaving for increase at all other offices,		$4,283

The $103,251 represents the increase of produce from, and merchandize to, western States, by the way of Buffalo. The $4,283 represents the increase over last year in the *home business*, or business of this State."

RAILROADS IN MICHIGAN.

We learn from the Detroit Free Press, though *we do not receive it*, but should like to, that there is now in successful operation in Michigan, 147 miles of railroad, as follows:

" From Detroit to Jackson,	- - -	80	miles,
" Monroe to Hudson,	- - -	42	"
" Detroit to Pontiac,	- - -	25—147	"

The cars will soon run 40 miles further on the Central road—from Jackson to Marshall, and 16 miles further on the southern road, from Hudson to Hillsdale, which will then give us 203 miles of railroad. We think this pretty fair for the youngest State in the Union."

So do we, and give the young State of Michigan full credit for her enterprize, and hope to see her persevere in her onward course which will certainly place her in an enviable position in a few years—especially if she *repudiates* that infamous doctrine of "repudiation."

Boston and Worcester Railroad.—We learn from the Boston Mercantile Journal that the second track upon this railroad is completed through its entire length from Boston to Worcester, and is now opened for use. We hope now to hear soon that the directors have also adopted lower rates of fare, so as not to throw the entire reduction made between Albany and Boston upon a part of the route.

We learn that the Mohawk and Hudson railroad company have effected a loan from the city of Albany of $150,000 at 5 per cent. With this money the company are to construct a new route of their road, which will terminate within the city limits, and will dispense with the inclined plane, now in use at the eastern termination. This change of route on the Mohawk road will be a great convenience to travellers. The inclined plane at Schenectady has been, or is about to be, dispensed with by adopting a new route. We should like to see a full statement of the actual cost of this road, from its commencement. It would show what experience sometimes costs. It should, however, be borne in mind that this road was commenced when inclined, planes and locomotives to run on 33 freet grades, and haul 20 tons on a *level* road at the rate of 10 miles an hour were the order of the day, and considered great performances.

The Brownsville (Penn.) News, says that out of a drove of 700 sheep which stopped at Beallsville, Washington Co., Pa., after one days drive 405 were found dead next morning, from having been over driven. This would not have occurred on a railroad.

Paterson railroad fare reduced from 37½ to 25 cents. Good.

Railroad Reports received since our last and will be noticed in our next number. South Carolina Canal and Railroad company, July, 1843. Georgia Railroad and Banking company, May, 1842 and 1843.

Rates of Fare and Freight received since our last and will be noticed

in the next number. A tariff of Freights and Passage on the South Carolina Hamburg and Columbia railroads; and on the Georgia railroad between Augusta and Madison; an abstract of which, we shall give in the October number. Will the managers of *other* roads please furnish us with a copy of their established rates? We design to make a table showing the rates comparatively, on all the railroads in the United States, if we can obtain them.

Otis' Excavator, of which an interesting description is given in this number, are to be used extensively on the St. Petersburg and Moscow railroad, in Russia. One machine was sent out last year, and three more, just completed by Eastwick and Harrison, Philadelphia, are now ready for shipment; and we understand that the owners of the patent, Messrs. Fairbanks and Carmichael, have taken a contract for the excavation of **25,000,000** cubic yards on this road.

Spring Steel for Locomotives, Tenders and Cars.—We desire to call the attention of manufacturers and others interested, to the following advertisement of J. F. Winslow, Esq., of the *Albany Iron and Nail Works*, at Troy, of *Spring Steel.* Mr. Winslow is, we believe, quite extensively engaged in the manufacture of steel, and from what we have seen and heard we believe he furnishes an excellent article.

☞ Thanks to those subscribers who have so promptly responded to our call upon them. If each present subscriber will do as some have already done—send two new names and cash with their own payment; in advance—the Journal will not be likely to lose time again soon.

☞ Thanks also to those Editors who have, in so kind a manner, noticed the Journal, and offered to receive subscriptions to it. As it is the only work of the kind published in this country, devoted mainly to Internal Improvements, in which all classes of people, and all parts of the country, have a deep interest, we shall be greatly indebted to all who will call attention to it as it appears, monthly, and send us, those who do not now, theirs in exchange. The Journal has been sent to Editors without the cover, in order to save them postage, and thus the whereabouts of its publication was omitted. It was presumed, however, that every Editor in the country, who had been long in the chair, knew where the Railroad Journal was, or had been published.

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AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5. | By GEO. C. SCHAEFFER, and D. K. MINOR, Editors.

No. 10, Vol. I. Third Series. | OCTOBER, 1843. | Whole No. 429. Vol. XVI.

RAILROAD POLICE.

Although we have often referred to this subject, we are convinced that much more may be said, and in fact must be said, in order to excite the proper feeling in regard to the most important branch of railroad economy.

The organization of a complete system of railway police is no slight task, and the difficulties are much increased by the essential differences which must prevail in all the minute details upon each line of road. Nevertheless, there are certain general principles which must in all cases be carried out, and the differences caused by local and peculiar circumstances are in all cases to be considered as the results of these principles.

The frequent occurrence of accidents of even trifling character, is most zealously to be avoided—as the confidence of the public becomes impaired and the character of railroads generally is injured. Certain accidents may be considered as unavoidable, but none should be unforseen and unprovided for, and the strict adherence to this view will of itself be the means of preventing many mischances. For example, any malicious obstruction sufficient to throw the engine or cars from the rails may be, as far as the company is concerned, strictly speaking unavoidable, yet the proper provision for this or similar occurrences will prevent unnecessary delay, which would produce an entire derangement along the whole road, and almost as a matter of course entail further accident.

As a general rule the greater the power and extent of any machinery the greater is the mischief resulting from any derangement of its operations, and this certainly holds good for railroads, as experience has fully proved.

The first grand principle is the preservation of life and property, and here the interests of the public and the company are concomitant, whether we regard the property of the company or that of the public or the lives of travellers or of the company's agents, the loss of one is sure to bring about the loss of one or more of the others, and injury to either is detrimental to the interests of all parties. No one doubts that wanton carelessness, resulting in loss of life is to be blamed and punished as the highest degree of man-

slaughter, and yet how very frequently can this wanton carelessness be detected, even though it may consist in the omission of a screw or a bolt in the machinery or of a single word in an order.

Next to the safety of person and property, *despatch* is the most important principle in railroad management, and without it the advantages over other modes of conveyance are wholly lost. It is not enough that an extraordinary trip has been or can be made, but swift passages should always be insisted upon, and regularity in this respect is more productive of traffic than any other cause.

Thirdly, the personal comfort and convenience of travellers should be carefully studied, and attention to this principle involves very many particulars. Cars should be comfortable and *clean*—the depots protected from the weather—the arrangements for the reception and distribution of baggage should ensure safety and despatch, the times of starting should be convenient and when determined upon, conspicuously published by advertisements and by notices at the depots—all changes should be made known a suitable time previous to going into operation and the time advertised should be punctually adhered to—civility and politeness on the part of all the agents of the company should be most strictly required. These are a few of the many items falling under this head, and of their importance there can be no doubt. It must be remembered that among travellers there will always be found a portion of invalids, females, children and of those who are not so wide awake as to know where to go and how to avoid danger without the plainest directions and the absence of all possibility of getting into mischief. Such is the travelling public as it is found and for such provision must be made.

The chief means of carrying out these principles is the promulgation of simple and comprehensive yet definite rules, and although these rules may be frequently broken without any serious result, yet to permit habits of inattention, fines should be exacted for every violation of orders—a method of securing attention and obedience which is calculated to succeed admirably if we are permitted to judge from the experience of those who have adopted it.

These rules should not only contemplate certainties, but provide for contingencies—"*if* such and such a delay takes place you are to do so and so," —and it is in this very point that the excellencies of a system of police are shown. If any accident happens, every thing still goes on with regularity and decision and the passengers are at once reassured by the absence of either stupid indifference, or visible trepidation and indecision in all the agents of the company. At the same time no solicitations or entreaties should be allowed to induce any one to depart from the rules laid down, and one good effect of such rules would be to prevent any such interference, simply by doing away with the necessity for it—but when passengers find there is no law and no order and that no means have been taken to ensure their comfort or to preserve their lives and property—they have a sort of right to in-

terfere, for self preservation, although, unfortunately in such cases they know as little what to do or how to do it as those who have got them into trouble.

A very good because very simple method of saving time and trouble, is the adoption of a badge or uniform by which all the persons connected with the railroad may be at once detected, and the addition of a label designating each man's office. This latter also incidentally insures another advantage—it prevents the making of "men of all work" doing everything, and nothing properly.

Such, in fine, are a few of the means of forming a correct system of police, but the best way of arriving at the details will be the publication of the rules adopted by each company, together with the local or other reasons for any peculiarities which may exist. With this view we would solicit from railroad companies and engineers, a copy of such rules as they may have adopted, for publication in this Journal—the result of comparison of information thus obtained will lead to a mutual improvement, give confidence to the public and insure profit to the railroads.

CHESAPEAKE AND OHIO CANAL.

The Baltimore Clipper of August 19th, says:—"The American of yesterday announces the election of Col. *James M. Coale*, of Frederick, as president of this company, in the place of Gen. McNeil. This change was made by the meeting of stockholders held in Frederick on Thursday last. This act we presume, is to be understood as intending to exhibit the disapprobation of the stockholders, of the contract lately made between General McNeil and Mersrs. Leston & Co.; and leaves no room to doubt that the work which had been commenced under the contract will be discontinued. Notwithstanding this decisive disapproval of the course pursued by General McNeil, we doubt whether it would not have been more politic to have permitted the contractors to expend the $100,000 as contemplated—for, as we understand the contract, they could not have proceeded further without special legislation; and of course their claims would have been limited to the tolls on the portion of the work constructed by them, for interest on their outlay, while the principal was not to be redeemed in less than twenty years.

We regret the misunderstanding between General McNeil and the company, because we consider him an efficient and experienced officer. Heretofore he has always, we understand, given entire satisfaction to the companies by whom he has been employed—and in regard to this company, we cannot believe otherwise than that he has acted with a conscientious conviction that he was doing what was just and right, and most conducive to the company. The contract he entered into being now annulled, what is to be done? The work yields nothing, and interest is accumulating. In this condition it is out of the question for things to remain long. The canal must be pushed ahead, or the State's interest in it be sold, even at a sacrifice—for it would be the grossest folly to continue a tax of more than $400,000 a year for a work which is not even progressing to completion, and which of course holds out no hope of reimbursement."

It is much to be regretted that this great work is to be still longer delayed. We do not pretend to understand the merits of the controversy between the president and the company, but on a recent visit to Cumberland we came to

the conclusion that the completion of the canal to that place is of the first importance to the stockholders as well as to the owners of the coal and iron region about Cumberland: and it is singular indeed, that when so much has been done, and so little, comparatively, remains to be done, ***Maryland and Virginia*** and the ***District of Columbia*** should allow it to remain unfinished. Perhaps this controversy may effect, by arousing the people to investigate the matter, what the president is not allowed to do under his late contract. The town of Cumberland and its vicinity as well as the District of Columbia, have a deep interest in the completion of this work; and it appears to us that the *whole* income of the canal for a period, had better be given to those who will loan the company the means of completing it to the coal region, for it is in fact a loan by the contractors to the company for twenty years, thus to receive the tolls on that part of the canal between dam No. 6 and Cumberland, opened by the expenditure of **$100,000** by the contractors.

Since the foregoing was written, we find the following remarks and protest in the Baltimore Clipper, which shows conclusively, as it appears to us, that the gentlemen representing, or rather *mis*representing the interests of Maryland, have done their late president very great injustice; and they must make out a very strong case of transcending his authority and instructions, or they will find him riding them rough-shod before they are aware of it. As the General says, we shall see."

"*Chesapeake and Ohio Canal.*—The summary dismissal of General McNeil from the presidency of the company, by the agents of the State of Maryland, without the formality of referring the subject to the consideration of a committee, or affording him the opportunity for explanation and defence, is considered harsh and unjust, and will become a matter for the investigation of the legislature. It seems, from the following protests, that the measure was in opposition to the wishes of the representatives of the large stockholders, with the exception of Maryland; and courtesy towards those representatives should have induced less precipitancy on the part of the agents of Maryland.

"General McNeil was invited to the station he lately occupied; and, we understand, left a more lucrative situation to accept the presidency of the company. He felt desirous to push the work on to completion with the least possible delay, and he had every reason to presume that the board felt like anxiety, as a resolution was passed, expressing a willingness to contract for finishing the work to Cumberland on the precise conditions, we believe, of the contract which has given so much offence. But if the president were even in error in making the contract in question, it did not afford a justification for his *sans ceremonie* dismissal from office, as there cannot be a doubt that in what he did he had in view the interests of the company. Having been denied the privilege of making his defence before those who discharged him, he will, we are informed, give an exposition to the public; when, we shall be much mistaken if he do not show that he has been unjustly treated.

"It is now evident that nothing will be done towards completing the canal until next spring, if then, and two hundred thousand dollars more of interest will accumulate in the meantime. This is wrong. It appears to be

adopting the policy of "saving at the spigot and losing at the bunghole." We are waiting for a cheaper contract, while we are losing in interest double the amount which we can hope to save by the cheap bargain. We wish the work to cost as little as possible, if it be completed at the expense of the State, and therefore desire to see it progressing, the procrastinating policy being ruinous.

"Col. Abert, in behalf of himself and others, asked leave to enter upon the proceedings of this day the following objections thereto, to be printed with the proceedings:

"1st. Because the meeting has refused the customary and just course of referring the matter in controversy in these resolutions, to the investigation and report of a committee.

"2d. Because the decision upon these resolutions is evidently made upon a one-sided report, from one of the parties involved, namely, the directors—a report which can be considered in no other light than that of a justification and defence of one party.

"3d. Because we believe that report to contain partial and erroneous inferences, personalities and harshness, eminently bearing upon the character and character and conduct of one of the parties, a report, which is, in fact, a defence of the directors, from themselves; and an attack upon the president, who was absent when said report was written and submitted to the stockholders.

"4th. Because we believe these matters require the investigation and opinion of an impartial and disinterested tribunal, namely, that of a committee of stockholders; without which course a just and impartial exhibition of the matter before the stockholders will not be in their possession.

"5th. Because that report from the directors brings new matters to the knowledge of the stockholders, not before brought to their knowledge; matters requiring deliberate and impartial investigation before a just decision upon them can be had.

"6th. Because from the personal explanation made this morning, August 17th, by the president, (who arrived last night,) we are the more convinced that investigation and report by a committee is necessary.

"7th. Because there is an application from the president, (which has been brought to the notice of the meeting this day) desiring that the matter may be referred to a committee to report at an adjourned meeting, and that he may be allowed an opportunity to be heard in his defence and justification. (Signed)

JOHN J. ABERT, (U. S. proxy.)
M. ST. CLAIR CLARKE,
ROBERT H. MILLER, (as proxy for corporation of Alexandria.)
CASPER W. WEVER,
SAMUEL BURCHE."

August 17th, 1843.

"The undersigned did not affix his name to the above protest, because he was disinclined to ask courtesy at the hands of those who had refused justice.

"The appointment of a committee, asked for by the representative of the United States and others was refused by the agents of Maryland, because they intended to return home the next day, and had not time therefore for an investigation: and the resolutions offered by the said agents were not discussed (so far as the undersigned was concerned) because he saw that the case was prejudged already; that the resolutions themselves were intened to carry out what it was admitted had been aimed at more than one month earlier, and before the contract referred to them had been entered into.

"For these reasons and more, the undersigned, at the moment of voting, made his verbal protest against the action of the agents of Maryland as *hasty and inexpedient.* He does so and in the same words still.

J. H. ALEXANDER."

For the American Railroad Journal, and Mechanics' Magazine.

CROTON WATER PIPES BURSTING.

We often hear of the main pipes, and also the house or service pipes bursting, by the great pressure of the water, and the public are not informed sufficiently on the subject. We are told, "that suddenly shutting off the water, is very likely to burst the pipe." In this "age of reason," we can generally trace cause and effect, and as we can in this instance, we will first make an assertion, and then endeavor to prove it.

"The water that runs through the pipe in this city, by its own motion given, by the head at the reservoir, can be made to burst almost any pipe through which it is allowed to pass with its full force, by stopping the motion of the water instantaneously, provided the pipe is long enough." We will now endeavor to prove the assertion; therefore we will say that a body of water is noncompressible, as much so as steel, or any other metal we now know of; we will set the water in motion, in a pipe whose length is represented by **1**, the weight of the water in the pipe as **1**, which strikes when in motion with that force, on shutting off suddenly. The pressure or power of the Croton water on the square inch we will also assume as **1**, and the *motion* of the water also **1**, (this is done to make it plain to all,) we will now take a pipe whose length shall be **100**, it will contain *one hundred* times the weight of water, with the pressure the same and the motion of the water the same; now should the stop-cock of this pipe be shut, the motion of the water with the same rapidity will cause **100** times the strain acting to burst the pipe, and the length of the pipe may be increased until the power is so great as to burst pipes any number of times thicker than those which now sustain the pressure of the Croton water.

Though the service pipes may be ten times as strong as the main pipes, yet the stronger pipe will burst first, because the motion of the water is but slightly affected in a **12** inch main, by a small stream of water being taken from it, even with great rapidity.

Say a **12** inch main is supplying a $\frac{5}{8}$ pipe, the water in the **12** inch main will run or move **1** foot while the water in the $\frac{5}{8}$ pipe will run or move over **311** feet, thus conclusively showing that if the pipe is burst by the motion of the water being suddenly checked, the $\frac{5}{8}$ pipe must be **311** times as strong as the **12** inch main, showing most conclusively that *no established strength of pipe* can do our citizens justice.

Proportion is the beauty of these arrangements which is always varying under these circumstances according to the length of the pipe and the mode of stopping the current of water.

This requires some very matured plan to prevent those who take the water into their houses, through a long pipe, being very seriously troubled

by their pipes bursting. Many may think that they are safe because their pipes stand the pressure of the Croton water, but practice has proved that a succession of blows in a pipe from what is called "the water hammer" will burst a pipe after it has been in use for some years.

You will hear from me again in your next number.

New York, August, 1843. CIVIL ENGINEER.

WESTERN RAILROAD—THROUGH FARE, REDUCED.

The competition that has grown up between this road and the river and sound navigation, it would appear by the following extract of a letter from an agent of this road, has induced the directors to reduce the *through* freight on flour to 20 cents per barrel. We have been informed, that with the new engines the company are procuring, that they can carry a barrel of flour with profit, at 12½ cents. It will be seen that all a railroad wants, is sufficient business to insure cheap rates of transportation.

The Western and the Worcester railroads are undoubtedly well constructed, but the heavy grades on the former, of 80 feet to the mile, with a rise of 1480 feet above tide in the short distance from the Connecticut river to the summit, with another summit between Springfield and Worcester of 900 feet, adds greatly to the expense of transportation, yet we find the nett earnings the first year on the whole line from Albany to Boston, 200 miles, at about 4½ per cent. The road, too, is in its incipient state. The directors, we will add, are learning their lesson, so to "fix the rates of transportation at low prices as to command freight, with an increase of nett income."

If flour can be transported 200 miles over grades of 60 to 80 feet for 11 miles for 20 cents per barrel, we do not see any difficulty in constructing a railroad from Buffalo to the Hudson, on a level or descending line, so as to carry it at the rate now charged by the State for tolls, to wit, 38¼ cents per barrel. If this can be done at a profit, and we do not doubt it, would it not be well to lay a track of *good edge rails* from Buffalo to the Hudson instead of enlarging the canal. If properly located and constructed, a substantial road, with a double track, need not cost to exceed nine millions of dollars.

We think it can be demonstrated, that with a railroad equal in construction to the Western, the Philadelphia and Reading, or the Boston and Lowell, the tonnage that now floats on the Erie canal can be transported by railroad at rates cheaper than the prices now charged on the Erie canal, provided the railway has half the business. It certainly can be done with the addition of the immense number of passengers passing this thoroughfare. Let us look at it. A calculation like the following, may be a safe one.

The tonnage floating on the Erie canal the last year exceeded 600,000 tons, say that two-thirds or 400,000 tons would equal the average of through tonnage for the season of seven months. Five trains, daily, would carry this tonnage at a handsome profit, at $4 per ton, from lake Erie to the Hud-

son. This would yield for *freight*, $1,600,000

With respect to *passengers*, it is not extravagant to estimate that calculating the *way* with the *through* passengers, that they would equal, if not exceed 100,000 per annum, paying from Buffalo to the Hudson. We think it will be double this number. At the moderate rate of $6 for each through passenger, we have 600,000

$2,200,000

If we allow the liberal rate of 50 per cent for expenses, and to keep the road in perpetual repair, we have $1,100,000 as the profit on an investment of $9,000,000 for a double track. J. E. B.

"I send you a statement of the rates for flour on the Western road:

"From Greenbush to Pittsfield	27	cents."
" " Dalton	30	"
" " Hinsdale	32	"
" " Becket	33	"
" " Springfield	33	"
To any station east of Springfield except Boston	34	"
To Boston	20	"

CANAL STATISTICS.

From the Albany Argus of 12th August, we take the following comparative statement of the business of the Erie canal for five years, to 1st August, each year.

"Comparative statement of flour and wheat shipped at Buffalo, Black Rock and Oswego, and also of the quantity arrived at tide water to 1st August.

	Shipped at Buffalo,		at Black Rock,		at Oswego.	
	Flour, bls.	Wheat, bush.	Flour, bls.	Wheat, bush.	Flour, bls.	Wheat, bu.
1839,	158,681	431,530	29,366	2,183	56,672	54,077
1840,	540,984	210,812	33,412	3,094	46,358	36,294
1841,	367,154	386,171	50,052	27,925	35,742	40,958
1842,	278,697	386,475	43,677	16,263	42,499	5,187
1843,	435,120	737,347	39,018	10,994	61,577	37 355

Arrived at tide water.

	Flour, barrels.	Wheat, bushels.
1839,	324,624	108,028
1840,	628,850	214,451
1841,	624,624	117,090
1842,	535,894	230,926
1843,	672,803	191,051

Taking flour and wheat together (the wheat being reduced to barrels of five bushels) the shipments at Buffalo, Black Rock and Oswego, and the arrivals at tide water to the 1st August, are as follows, viz:

	Shipments, equal to	Arrivals, equal to
1839,	342,277 bbls.	346,224 bbls.
1840,	478,795 "	671,740 "
1841,	544,719 "	648,042 "
1842,	424,458 "	582,081 "
1843,	690,854 "	711,013 "

The above statement shows that the arrival in each year at tide water to

the 1st August, since 1838, has exceeded the import from western States as follows. Of the arrival at tide water there was

	From western States. bbls.	From this State. bbls.	Total. bbls.
1839,	342,277	3,947	346,224
1840,	475,795	195,495	671,740
1841,	544,719	103,323	648,042
1842,	424,458	157,623	582,081
1843,	680,854	20,159	711,013

These excesses of arrival of flour at tide water in each year to the 1st August, over the imports from western States to the same time, represent the surplus of our own State, coming to tide water in each year.

Merchandize.—Statement of the tons (2000 lbs.) of merchandize sent from tide water, and of the quantity received at Oswego, Black Rock and Buffalo, to 1st August, viz:

	Shipped at Albany and West Troy.	Oswego.	Delivered at Black Rock.	Buffalo.
1839,	59,779	5,230	58	20,789
1840,	43,255	2,766	47	10,139
1841,	55,972	5,174	29	13,681
1842,	39,258	4,189	28	10,652
1843,	44,666	3,899	5	14,980

In connection with the preceding valuable and interesting statements, we repeat the account (given on Monday) of tolls received on all the canals of this State, and of the lockages at Alexander's lock, three miles west of Schenectady, to the 1st August, viz:

	Tolls.	Passages at Alexander's lock.
1839,	$761,423	10,646
1840,	716,526	11,555
1841,	912,224	13,486
1842,	750,951	10,090
1843,	858,485	9,668

The increase over last year is		$107,534
Of this increase there is at Buffalo	68,459	
" " West Troy	28,424	
" " Albany	6,368—	103,251
Leaving for increase at all other offices,		$4,283

The $103,251 represents the increase of produce from, and merchandize to, western States, by the way of Buffalo. The $4,283 represents the increase over last year in the *home business*, or business of this State."

PROFESSOR MORSE'S ELECTRO MAGNETIC TELEGRAPH.

We have been recently favored with an opportunity of witnessing some remarkable experiments preparatory to the construction of the telegraphic line between the cities of Baltimore and Washington. Wires to the total length of 158 miles having been prepared, it was thought proper by Professor Morse that this unusual length of wire should be used as a test of the powers of his system and also as a means of determining such points of scientific inquiry as might depend upon the employment of apparatus of such remarkable magnitude.

Several scientific gentlemen were present—Prof. Renwick of Columbia

college, Prof. Draper of the New York city University, Prof. Ellet of the south Columbia college, J. R. Peters, C. E., and Drs. Fisher and Gale, assistants to Prof. Morse. The arrangements from their temporary character, were not intended to show the perfect working of the finished telegraph. The powerful battery employed was operated under the disadvantages of imperfect insulation and the dampness of the earth above which they were supported—this was feelingly demonstrated by the liberal supply of shocks given in every direction by the slightest contact. Notwithstanding the disadvantages the results were such as to afford the utmost gratification to all present. The battery employed was of the form known as "Groves' Constant Battery," with plates of platinum in pure nitric acid, and amalgamated zinc in dilute sulphuric acid—the two liquids separated by a porous diaphragm. One hundred of these pairs were sufficient to work the magnets through the whole 158 miles of wire, and that too, in the space of a scarcely appreciable fraction of a second of time. A portion of this interval was consumed in overcoming the resistance of the spring attached to the moving point and the friction of the joint, so that as far as speed of communication is concerned we may safely say that the action is instantaneous through this length of wire. This result although in accordance with the known laws of electric action, was yet, gratifying as affording a confirmation of them when applied to an "extreme case." The use of a larger number of pairs, of course increased the power of the magnets.

A series of experiments was then made to ascertain the resistance to passage of the electric current by various lengths, of from 2 to 158 miles of wire. The result was again in accordance with what had been predicted. This resistance increases rapidly with the first few miles, and less and less rapidly afterwards, until for very great lengths no sensible difference can be observed. This is a most fortunate circumstance in the employment of electro magnetism for telegraphic purposes, since, contrary to all other modes of communicating intelligence, the difficulty to be overcome decreases in proportion to the distance.

Several other experiments, suggested by the unusual opportunity of a very large battery, were then made—and one circumstance throughout the whole time consumed, several hours, was worthy of note—we refer to the remarkably constant effect of the battery. This is one of the advantages of recent improvements, since the apparatus formerly in use, was subject to a very rapid and permanent loss of power.

Since these experiments were made, we have seen in the Glasgow "Practical Mechanic and Civil Engineers' Magazine," a description of the telegraph of Messrs. Cooke and Wheatstone—a more recent invention than that of Prof. Morse, as may be seen by a reference to our number containing the report of the committee in congress, on the bill giving an appropriation for a trial of Prof. Morse's plan. Notwithstanding the early date of this invention, 1832, the article in question gravely asserts that the history of electro magnetic telegraphs dates from the year 1836, although the prior-

ity of invention by Prof. Morse, was known to most of the scientific men of Europe.

An attentive examination of the two plans, will soon convince any one understanding anything about such matters, that they never can become rivals. The telegraph of Cooke and Wheatstone, although similar, to that of Morse in principle, is totally different in its applications. In the English telegraph a number of signs to denote the letters of the alphabet or the signals of an arbitrary code are *exhibited*, not written down. They may be compared to the manual alphabet of the deaf and dumb, with this exception, that three successive signs are required for some letters, and the dial must be attentively watched or the signals are lost and cannot be recovered unless by a second transmission. In the American telegraph the intelligence is written down, and anything expressed by ordinary written language, letters, figures or cyphers, may be instantaneously transmitted and recorded, even in duplicate, triplicate or quadruplicate, if desirable. The absence of an attendant, therefore, makes no difference in the reception of intelligence. The American invention has the advantage, also, in point of expense and from several ingenious improvements in the mode of preparing and laying the wires, we feel assured that its liability to derangement is far less than that of the more costly English telegraph.

In its most elementary form the apparatus of Cooke and Wheatstone has been in use upon several railroads, and if the power of transmitting but two signals, as on the Blackwall railway, is worth the original outlay, the possession of an unlimited communication for the purposes of the company or of individuals, must certainly be worth much more, and yet the cost is in fact less.

A single track of railroad of any length can be made as effective and as safe by means of this auxiliary, as any double track can be, and this too, at an original outlay of about the sum required annually to keep a track in repair. The advantages to railroads of this important invention can easily be understood by those familiar with railroad management, and if to these we add the profit to be derived from the transmission of intelligence, we certainly think there is ample inducement for its employment upon every railroad in the United States.

RAILROAD SUCCESS.

Who can say that railways are not profitable? The Attica and Buffalo railroad, commenced two years since, has been finished and put into operation, at the very moderate cost below named. A semi-annual dividend of 3 per cent., too, is declared for the first six months. We are sorry that such enterprize and such a reward should not belong to the citizens of our own State. But if New England builds our railroads it is no more than fair that she should be handsomely remunerated.

Attica and Buffalo Railroad.—The whole length of the road, including branches and turnouts, is 32 miles, constructed in a good substantial man-

ner at a total cost of $259,366. The personal property owned by the company consists of three locomotive engines, six first class passenger cars, five second class passenger cars, two baggage cars, one mail car, twenty-five freight cars, and cost $31,307.

The receipts of the road from passengers, exclusive of pay for carrying the mails, for the four weeks ending August 20, were $6,310·94. Whole number of passengers carried during those four weeks, 9630. The current expenses for running and repairing cars and road in the same time was $1,305·76. The directors have just declared a semi-annual dividend of 3 per cent.—*Buf. Com. Adv.*

REPORT OF THE ENGINEER IN CHIEF OF THE GEORGIA RAILROAD AND BANKING COMPANY.

To the Hon. John P. King, President Georgia Railroad and Banking Company:

Sir: An unavoidable absence from the State until within a few days past, will prevent me giving as detailed an account of our operations since the last convention, as I had intended. I trust, however, that the stockholders will be able, by a careful examination of the numerous statements accompanying this report, to satisfy themselves as fully of the condition and state of their affairs as though I had been more comprehensive in my remarks.

The extension of our road beyond Madison, so frequently agitated, has been commenced during the past year, and it is to be hoped that the exertions of the company to continue its progress to the State railroad, will be unremitted. There never was a period more propitious for the execution of such work than the present, and by a continued and vigorous prosecution of the enterprize, we shall be enabled to witness its entire completion, in time to meet the tide of prosperity which there is now every indication, will shortly dawn upon our country.

There is no section of the Union, having equal local advantages, where land can be procured on such favorable terms, as in the extensive region to be drained by the Western and Atlantic railroad. The expense of transporting produce to market, has heretofore retarded its growth; but as this difficulty will shortly be overcome by the completion of a continuous line of railroad from the sea-board, stretching around ours 350 miles into the interior, we may expect a rapid increase in her population and wealth. Notwithstanding the sparseness of its present population, a large share of our business is now derived from this region, which, if we should fail to connect with the State railroad, will in a great measure, be lost to us. We shall then be thrown back for support upon the trade of the old counties from whence Augusta derived her prosperity. These, though originally possessing a bountiful soil, have, by a false system of agriculture, become exhausted, and are now unable to afford us a large transportation. The opening of fresh counties in the west and north west section of the State, has hitherto sustained the prosperity of this city; but if we should pause in our progress, these new streams will be diverted to other channels, and as a necessary consequence, she must continue to decline.

Our contracts for grading, terminate near Covington, about 23 miles above Madison. From this point, we think, that if the road should not be farther extended, we shall be able to command, in consequence of the present superiority of the Augusta market, and the choice of those on the seaboard, which our route presents in an eminent degree, the transportation of the larger portion of the cotton produced by the counties west of us. It will also give us an important advantage in the transportation of the mail and passengers, and enable us to obtain the much desired object of traversing our road with the mail train down, for the most part, by day light.

Our present contracts end at a point convenient to pass from thence, either through Covington, or by a more direct route, leaving it about one mile to the left. The distance saved by this cut-off is seven-eighths of a mile, and the cost of graduation, etc., lessened by it $17,000, to which should be added for the cost of the superstructure on the distance saved, and the capital on the annual amount expended to sustain the increased length of road, and the consequent additional cost of transportation thereon, $14,000; making the whole actual saving, $31,000.

Under a contract with the Middle Branch railroad company, we agreed to pass through the village of Covington: the charter of that company having expired, the legal binding of that contract has ceased; but the moral obligation to fulfil it, is still in force, and it appears to me that it can only be removed by the consent of the individuals with whom the contract was made, or their assignees, voting in proportion to the interest held by each in the company. Whether efforts to obtain their consent shall be made, is referred to the consideration of your board.

The estimated cost of preparing the road between Madison and Covington (26 miles) for the reception of the superstructure, is $215,000, including the purchase of the right of way. Of this sum, $170,000 will be provided for by the Newton county stockholders, under an arrangement with them to work out their indebtedness for stock, upon terms that were considered equitable and just between the parties. The remainder will have to be met by cash payments. The grading and bridging on the line beyond Covington, including the right of way, is estimated, at the present reduced price of labor, at $175,000, making the cost of preparing the road bed on the entire extension of the line to the Western and Atlantic railroad, $390,000.

The superstructure will vary according to the plan adopted, and the contingency of the admission of the iron free of duty, from $275,000 as the minimum, to $475,000 as the maximum cost. From recent information, I entertain little doubt, but that the duties on the heavier description of iron rails, will be remitted by the next congress, in which event the cost of the superstructure laid with a T rail, will not at the present price of iron, exceed $370,000. The whole cost of the road, 68 miles in length, would then stand thus:

Grading, bridging and right of way,	390,000
Superstructure,	370,000
Superintendence, etc.,	30,000
Total,	$790,000

equal to $11,600 per mile, which is unusually low, considering the broken nature of the ground, encountered in passing the valleys of the Alcovy and Yellow rivers. The first with a bridge of 1000 feet in length, and 72 feet above the water, and the other 400 feet long, and 65 feet high.

The upper half of the road, will traverse for more than 30 miles, a ridge presenting throughout its course, a remarkably even profile, the average cost of grading upon which, will not exceed $3,000 per mile. This part of the route, encounters the whole of the far-famed "difficulties" presented by the "Stone mountain and its numerous spurs."

The grading and bridging now in progress, will be completed in about 15 months, and the remainder of the line can be executed, if commenced during the ensuing winter, as rapidly as the superstructure can be brought up with it.

The business of the road this year, has in the aggregate, exceeded that of last year, $23,771·31, the increase on freight, is $32,185·18, and on mails, $2,029·26, while for passengers (and some other small items,) there has

been a falling off of $10,443·13. The causes that have produced this decrease, are traceable solely to the extraordinary depression in the price of the staple of the country. The loss has been nearly uniform at all the stations, except one or two which have not fallen off, in consequence of known local causes.

It will be perceived, however, that there has been an increase in way passengers, (or those passing between intermediate stations,) the receipt from whom, this year, are more than 10 per cent. of the whole travel. The revenue from this source, for the week ending April 1, 1841, was only $3,505·30, for the year ending April 1, 1842, it was $5,256·18, and for the present year, it is $6,510, exhibiting a uniform and gratifying increase each year, notwithstanding the inconvenience which such travel is placed under in consequence of our night schedule.

Since the close of the year, our books show an increase in our receipts for both passengers and freight, over the corresponding months of last year. In up freight the gain is nearly two-fold, and it is in a great measure derived from our Tennessee and Alabama customers, who if our road is not pushed forward, will unquestionably seek another channel for the transportation of their goods.

Some efforts have been made, which have not yet proved successful, to organize a ticket by which a reduction in the rates of passage could be effected on travel going entirely through, from Montgomery to Baltimore, so as to enable us in connection with our greater speed, to compete with the boats on the Mississippi. In consequence of the numerous interests to consult, the arrangement has not yet been perfected, but it is believed that most of the difficulties have been removed, and the experiment will, in a short time, be fairly tried. The extension of the same system, through to New Orleans, would be desirable, but as there are no regular packet boats, at present established on the Alabama river, that run at all seasons of the year, a connection could not be formed, immediately, that would be satisfactory.

Our rates of freight on cotton were reduced last season, to an average of 40 cents a hundred pounds, per 100 miles. This rate, I believe, gave to us the largest nett profits that we could have derived from the crop. A lower rate would possibly have given us more business, but we could not have gained a sufficient number of bales by a further reduction, to cover the loss that would have been sustained upon that carried. Instead of future reductions to any extent, it has been suggested that we give to the customers of the road, some conditional right of passage to Augusta on more favorable terms than the ordinary travel.

It is proposed to revise during the ensuing summer, our tariff on up freights. A reduction may be made on some articles, but our rates are conceived to be, generally, low enough. There is no part of the duties connected with the management of railroads, that require as much consideration as the charges on freight. While too high rates will in a short time lessen the amount of the receipts of the road; on the other hand, a very reduced scale, may add greatly to its business, without a corresponding increase in the nett profits. A just medium is to be observed, and can only be obtained by a full knowledge of the nature of the transportation expected, and the sources from whence it is to come, together with the controlling circumstances calculated to divert its passage from over the road. The knowledge obtained on this subject, during the time the road has been in operation, we trust will enable us to fix a scale which will give satisfaction to our customers, and at the same time, meet the paramount interest of the stockholders.

The following summary statement, will show the business of the road,

and the expenses incurred in working it, during the year ending on the 31st of March last. The usual statements giving the business and expenses in detail, will be found among the papers accompanying this report:

Cr.

By amount for passengers up,	30,637 84	
" " down,	31,297 46	
" " extra trips, extra baggage, lots of negroes, etc.,	1,105 51	
" " freight up,	69,591 43	
" " " down,	84,574 07	
" " " between stations,	725 15	
" " premium and rents,	913 00	
" " transportation of mails,	29,182 48	—248,026 94

Dr.

For expenses of conducting transportation,	25,170 02	
" " motive power,	30,220 34	
" " maintenance of way,	44,684 34	
" " " cars,	9,744 37	—109,819 07
Leaving nett profits,		$138,207 87

Our contract with the post office department has been renewed, at the same rate of compensation per mile, received under the old agreement, commencing the new service on the 1st of July next.

We proposed to transport the great mail, starting from either end of the road, at such hours as the department might designate, at an average speed at night of 11 miles per hour, for the annual compensation of $300 per mile, or at $237½ per mile, leaving Madison at 3 P. M. The first proposition was rejected, on the ground that the funds of the department would not justify an increase in railroad compensation, beyond the old price, ($237½ per mile,) and the second was finally acceded to, by changing the hour of starting from 3 to 5½ P. M. By the completion of our road to Covington, however, we shall be able to change the schedule so as to reach Augusta before midnight.

The decision of Mr. Kendall, in relation to railroad mail compensation, was to allow $237½ per mile, to such roads as surrender the control of their hours. The present post master general, has so far deviated from this rule, as to allow this price to all railroads on the great mail route, indiscriminately.

Under this arrangement, the S. C. C. & R. R. Co. receive for a day schedule of only 13½ miles per hour, the same rate allowed to us, for night service both ways. In Mr. Kendall's decision there was some fairness, but in the present, there is none.

Under the schedule adopted between Washington and Madison, the mails will arrive with much more regularity than formerly. If failures occur, they must arise chiefly from the late arival of the boats at Charleston, which could be prevented in a great measure, by a later hour of departure of the cars from that city; there being ample time west of it. In fact, many of the failures which have heretofore taken place, may very properly be placed to the account of the S. C. R. R. Co., whose adherence to an early departure from Charleston, has been an important cause of the derangement in the line, and a serious inconvenience to their neighbors, which will be only partially overcome by their consenting to leave at 9 instead of 10 o'clock A. M.

Our motive power has been greatly improved, and it is now capable of performing 50 per cent. more work than we have at any time had occasion

for. Under these circumstances, I did not hesitate to embrace an offer from the State of Georgia, to purchase from us the locomotive Florida, which has since been delivered upon the Western and Atlantic railroad.

Although the distance run (152,873 miles,) by all the locomotives during the year exceeds that of the previous year, only 353 miles, yet we brought down with them 23,000 more bales of cotton, showing an increased efficiency in their performance, of 50 per cent., which however, is partly to be accounted for, from the circumstance of being able to obtain more frequently, full loads. The expenditures in this department, notwithstanding the improvements of machinery, which are still progressing, is but \$30,220 34, about the same as last year. The ordinary repairs of engines, were \$7,790 90, and extraordinary repairs, but \$76 00, the last occasioned by an accident to the night line. The saving in this item, compared with that given in previous reports, exhibits clearly the advantages of a slow speed for freight, and a fixed schedule to run to by freight, as well as passenger trains.

One of our small locomotives, (the Tennessee,) has been altered to Baldwin and Whitney's patent 6 wheel freight engine, and now weighs about 11 tons. It ran but a few trips, after it was received, before it met with an accident, caused by the weakness of the shackle pins, which are being repaired by the patentees, upon a more substantial plan. The performance of the machine while running, was entirely satisfactory. It drew up our steepest gradient, 37 feet per mile, a gross load of 240 tons, exclusive of engine and tender. This improvement if successful, and I now entertain but little doubt on the subject, will be of great importance to railroad companies, especially to those who have laid down the ordinary plate rail.

We have erected an iron foundry adjoining our machine shops, which has been leased for an interest on its cost, under a contract with the individual renting it, to execute our castings at 1½ cents per pound. By this arrangement, we get our old wheels converted into new ones, for about \$7 00 each, which will effect a considerable saving in our future outlay for cars. We have succeeded in giving the wheels as deep and uniform a chill as those obtained from the best manufactories at the north.

The expense of maintaining the road, has according to our expectations, been greater than any previous year, and probably will not again reach the present amount. Next year it will be considerably less, if nothing extraordinary should occur. The average cost per mile, is \$303.

The accounts for next year, will exhibit a considerable saving in all the branches of the business of the company, owing to the reduction in the price of labor, provisions and materials, together with the improved condition of our machinery.

Our nett profits this year, are about 6 per cent. upon the cost of the *whole road*, and I cannot think that they will, at any time, be much less than this rate. The returning prosperity of the country, would lead us to hope that they would soon greatly exceed it; a hope which is only clouded by the anticipated interference of rival improvements.

Respectfully submitted by your obedient servant,

J. Edgar Thompson,
Chief Engineer and general agent.

Statement of the Yearly Expenses incurred for working the Georgia Railroad, from April 1, 1839, to April 1, 1843.

	Year ending April 1, 1840.		Year ending April 1, 1841.		Year ending April 1, 1842.		Year ending April 1, 1843.	
CONDUCTING TRANSPORTATION.								
Stationery and printing,	589 55		475 04		777 56		585 69	
Loss and damage,	1,666 93		738 67		1,909 18		382 34	
Incidentals,	1,101 31		883 45		1,624 68		1,866 08	
Oil and tallow for cars,	288 61		182 78		402 72		410 97	
Provisions, clothing, etc., for negroes,	4,041 57		2,593 98		2,849 42		2,862 07	
Expenses of mules, Warrenton branch,	360 25		799 43		1,062 62		591 10	
Expenses of horse car, Athens branch,					583 34		2,336 33	
Wages, laborers,	4,522 59		2,355 11		2,022 24		3,958 23	
Agents and clerks,	7,467 89		7,356 39		8,742 88		9,329 42	
Conductors,	3,927 81		2,484 75		2,024 83		2,663 79	
Work done by car factory,					220 50		152 50	
Work done by machine shops,					480 00		31 50	
		23,966 51		17,869 60		22,699 97		25,170 02
MOTIVE POWER.								
Stationery and printing,	59 17		16 25		13 08			
Expenses of water stations,	3,009 40		2,480 98		2,518 11		2,061 12	
Incidentals,	70 82		27 95		329 49		184 62	
Fuel,	6,839 24		5,402 87		7,186 61		6,405 12	
Oil and tallow for engines,	3,108 84		1,177 54		1,538 73		1,411 34	
Ordinary & extraordinary rep's to eng's,	6,403 38		6,792 19		9,610 28		7,866 90	
Improvements to engines,							2,288 00	
Engine drivers and firemen,	7,523 73		4,715 13		7,079 33		7,151 14	
Provisions, clothing, etc., for negroes,	1,503 59		2,039 97		1,735 42		2,852 10	
		28,518 17		22,652 88		30,011 05		30,220 34
Carried over,		52,484 68		40,522 48		52,711 02		55,390 36

Statement of the Yearly Expenses incurred for working the Georgia Railroad, from April 1, 1839, to April 1, 1843, (*Continued.*)

	Year ending April 1, 1840.		Year ending April 1, 1841.		Year ending April 1, 1842.		Year ending April 1, 1843.	
Brought forward,		52,484 68		40,522 48		52,711 02		55,390 36
MAINTENANCE OF WAY.								
Mens' wages,	12,514 12		12,103 67		19,549 58		18,322 73	
Supervisors,	1,999 94		1,699 96		1,733 29		2,724 23	
Provisions, clothing, etc., for negroes,	2,174 69		1,592 35		2,703 06		1,764 62	
Incidentals,	229 26		180 49		524 99		809 49	
Tools,	414 07		377 56		826 99		399 78	
Iron and spikes,					550 47		1,969 66	
Wooden rails and cross ties,	1,401 17		5,446 38		11,382 80		16,046 74	
Repairs of culverts,							376 88	
Work done by car factory,			436 20		511 16		795 70	
Work done by machine shops,					910 17		1,474 51	
		18,733 25		21,836 61		38,692 51		44,684 34
MAINTENANCE OF CARS.								
Ordinary repairs,	4,936 30		4,725 20		3,660 00		2,144 37	
New baggage car,							1,050 00	
Renewal of wheels,					1,167 50		3,098 63	
Renewal of Axles,							351 37	
New platform car,							2,500 00	
Extraordinary repairs,	480 00		189 15		1,287 00		600 00	
		5,416 30		4,924 35		6,114 50		9,744 37
		$76,634 23		$67,283 44		$97,518 03		109,819 07

For the American Railroad Journal and Mechanics' Magazine.

ON A NEW APPLICATION OF RAILWAYS.—BY ELLWOOD MORRIS, CIVIL ENGINEER.

It is well known that prior to the introduction of the modern railway system, cities were chiefly furnished with provisions, from a space covered by the revolution of a very limited radius, whose length was determined by the distance which horses could travel within a few hours; while but very moderate supplies indeed, were ever drawn from a greater distance than a days' drive.

An immediate result of the greatly augmented speed of travel, consequent upon the construction of any modern railway leading from a city into the interior of the country, is a direct and considerable extension of the surface, capable of becoming with advantage, *tributary to the market of that city.*

The large augmentation of the surface of production, tributary to any market consequent upon a diminished cost and increased speed of transport, must inevitably have an effect upon the value of provisions there, and it will follow hence, that whenever the railway system shall be properly availed of for the supply of our cities, the selling prices of country produce in their markets, *must fall*, and their numerous inhabitants be thereby benefited.

This is but another phase of the important economical revolution, which the great iron roads of modern days, are gradually producing, in all that is in any way dependent upon the cost or time of carriage.

Upon the European railways, the highest advantages seem to have been derived from the facilities they furnish for the cheap and easy carriage, from great interior distances, of live stock and other provisions destined for the supply of the overgrown communities there assembled in the great cities.

Even in our own country their influence in the aspect referred to, is begining to be strongly, as well as beneficially felt, and one railroad corporation at least, has profited considerably by the establishment of a market train, regularly drawn, like other freight, by locomotive steam power.

We refer to the Camden and Amboy railroad company, the directors of which, in their elaborate report of 1840, upon the completion of their works, describe the success that has attended the establishment of a regular market train upon their railway, which has been the means of opening for the supply of the provision market of New York, a large district of country, practically inaccessible before.

In the report referred to, at page 11, we find the following statement:

"Two years since at the request of some market people in New Jersey, a line called *the pea line*, with two cars, was occasionally started from Camden to New York, with no other view or expectation than the accommodation of a very useful and respectable class of men. This line has steadily increased until it has become profitable beyond all expectation. During the past year, it has been running daily, sometimes taking with it as many as sixteen cars, laden at the appropriate season with peas, peaches, potatoes, as-

paragus, cabbages, live stock, and upon one occasion (as incredible as it may seem) *thirty tons of green corn!*"

The European railroads have been found extremely beneficial in the transportation of live stock, and other provisions to the great cities, which have thus been enabled to draw their supplies from a much larger surface of country, and consequently at a smaller price.

Since the completion of the Baltimore and Ohio railroad to Cumberland, extravagantly high prices can no longer be commanded for agricultural products on sale in the Baltimore markets; thus with the article of *butter*, it has been recently observed that whenever it becomes unusually high, large quantities are promptly sent down by the farmers beyond Harpers Ferry, and prices fall at once.

So strong indeed is the influence of this railway in regulating, and keeping down to a moderate standard, the market prices of Baltimore, that it has already become a subject of complaint, with those who, from the nearness of their position, have heretofore been able to hold a monopoly of the supply.

Other facts might readily be adduced, which in connection with the remarkable experience of the Camden and Amboy company, would show in a striking light the advantages which must follow the introduction of market cars upon railways, and will ultimately among other results, tend to soften the prejudices still entertained by some against railways as aristocratic monopolies, since by reducing the cost of the necessaries of life to all, they will recommend themselves in the strongest manner to a large majority of our population.

With the introduction of market trains upon railways, *provision depots* become desirable, and the first of these which has fallen under the notice of the writer, where provisions brought in railway cars are kept on sale, both wholesale and retail, is that lately erected in the city of Philadelphia in connection with the Columbia railroad, and opened in June of this year, under the denomination of the *car market.*

It is this new application of railways—*to the formation of a railroad market*—that it is proposed briefly to describe.

The idea of constructing a *railway market*, having been for some time entertained by Mr. Samuel Webb an intelligent and enterprizing citizen of Philadelphia, who foresaw the advantages that must flow from the transportation of provisions by the railways centering upon that city; he applied to the writer during the past year, to work out the practical details, and superintend the construction of *a car market house*, of which he furnished the outline.

This building has accordingly been erected; it was opened to the public in June last, and promises to be very successful.

The *car market* is 200 feet long, and 40 feet wide, it fronts on Schuylkill Seventh street north of Callowhill, its axis being parallel to the State railroad leading to Columbia, and 130 feet distant from the southern sidcling.

In consequence of the position of the building, it was necessary to enter

it through the north flank by reversed curves, with a short tangent between: this is effected by turning out of the Columbia railway to the right, upon a curve of 80 feet radius and 51½° deflection, into a tangent running off obliquely at that angle; thence by this tangent 90 feet, and then by another curve of 80 feet radius and 51½° deflection, turning to the left we curve into the axis of the market house.

Through the centre of this building longitudinally, from end to end, a straight track of railway is laid, and to enable the empty cars to pass out without interference, a return track is provided, which by a radius of 48 feet turning 128½° of curvature, re-enters the oblique tangent before mentioned.

All of these curves are laid with a common railway superstructure, and though their radii are so very limited, they nevertheless answer their purpose satisfactorily.

The writer will here observe in passing, that for the ordinary entrance tracks of depots, a common railway superstructure, where all the wheels run upon their treads as usual, will answer very well when curved upon a radius of 80 feet, and of the numerous side tracks recently laid here, to accommodate the coal trade descending the Reading railway, nearly all the curves are ordinary railroad tracks, and in some of them radii of curvature of less than 80 feet, have been adopted without inconvenience.

The car market is near 37 feet wide in the clear, and the stalls are made to project out 8 feet, at every 16 feet lineal of the walls, forming recesses between, and leaving a central promenade of 21 feet wide, entirely unincumbered, except by the pillars which carry the second floor.

This arrangement allows ample space for purchasers, even when the central railway is filled with cars, and by means of the projecting stalls, furnishes a great developement of stall surface, for the exposure of provisions on sale.

The building is of stone, two stories high, and the second floor is destined in the course of time, to be also used for the sale of the lighter articles of marketing, which, brought to the market in cars, will then be elevated to the next story, by some convenient means.

Such is the outline of an enterprize which will probably form a prototype for others on a more extended scale, *since the idea acted upon seems to be a sound one, and must eventually have a very important effect, upon the provisioning of those cities, which by their railways, command the interior country.*

RAILWAY COMMUNICATION BETWEEN PARIS AND THE NORTHERN PORTS OF FRANCE.

By the politeness of Mr. Joseph E. Bloomfield, we have received a copy of the report of Mr. Robert Stephenson to the directors of the South Eastern railway. The valuable information to be found in this document upon one of the most important lines of railroad in Europe, has induced us to give an abstract of portions of Mr. Stephenson's report.

In 1835 under the direction of the French government M. Vallee ex-

amined the whole of the northern lines of railway and reported fully thereon. The lines recommended by M. Vallee contemplated a route direct to Amiens and thence two diverging lines, one to Boulogne and another to Calais—two points of union with the Belgium railways were likewise indicated. Under the arrangements then proposed by government, negotiations were made with a Mr. Cockerill which were finally abandoned on account of the inadequate aid offered by the French government.

"The plan recently proposed by the minister of public works, and approved and authorized by the Chambers, consists of bringing the funds of government in aid of private enterprize, and should fair and equitable terms be obtained from government, there cannot be a doubt that such an arrangement will prove highly beneficial to the individual as well as to the country at large.

"The outline of the government proposition is this:

"They engage to purchase all the necessary land and construct the whole of the earth-work, bridges, and stations, leaving to the company the execution of the upper works of the railway, that is to say, laying the rails, chairs and ballasting, and to supply the whole of the carrying establishment, viz. locomotive engines, wagons, etc. For this expenditure the company are to work, and have the entire profits of the working of, the line for a given number of years; at the expiration of which, on the purchase of the then existing stock at a just valuation, the government become the sole proprietors of the railway. It is further proposed, that if the company prefer executing the earth-work, bridges, etc., leaving solely to the government the purchase of all land required for the works, and the construction of the stations, the government will pay to them such sums as may be calculated to afford an ample profit for the execution of these works. The company will possess the entire control of the undertaking from the commencement, subject only, of course, to such laws as are expedient for the establishment of public security, and the maintenance of the public welfare. The lease, under these conditions, would, of course, be limited as before, and at the expiration of it the government become possessors upon the same terms."

The remarks of Mr. Stephenson upon the singular restrictions imposed upon M. Vallee are of sufficient professional interest to be given somewhat at length.

"Before taking up the detailed examination of M. Vallee's plans and sections, it is necessary that I should allude to one or two of the engineering instructions, which he appears to have received from the French government, and under which he seems to have acted in almost every case, and in many, if we may conclude from the tone of his remarks, against his own judgment.

"The restrictions I refer to are—

"1. That no curve should be made under 1,200 metres in radius.

"2. That no gradient should exceed 3 in 1,000, or, as it is expressed by English engineers, $\frac{1}{333}$, or about 16 feet a mile, and

"3. That all curves of small radii should be level.

"In deputing an engineer to examine a tract of country extending from Paris to Belgium, and to the ports lying contiguous to England, and embracing several marked and difficult physical features, it were hard to conceive instructions better calculated to fetter the free exercise of his judgment and prevent the results of his survey being practically useful, than those just laid down.

"Those instructions would no doubt compel him narrowly to study every feature of the face of the country, for with limitations of this kind, the designing a line of railway over so extensive a district, must necessarily prove a matter of extraordinary difficulty; indeed, so distinctly has this proved to be the case, that, in some of the lines laid down by M. Vallee, he has been driven to the necessity of abandoning, in a few instances, the letter of his instructions; and, in the projected line between Etaples and Boulogne, the increase of work occasioned by an adherence to his instructions, has been of so extensive and glaring a character, that he has felt himself called upon to allege two untenable reasons for that adherence, namely, the short distance along which the difficult features present themselves, and the necessity of decreasing the load of every train on its approach to this incline, should he establish it at **5** instead of **3** in **1000**; in fact, such deviations have only been applied to the sections, where the surface of the country actually defied the application of the government regulations, except by the adoption of such expedients, as would have appeared, when developed, obviously preposterous. The nature of the country having in such cases proved unmanageable under those restrictions, and consequently having thrown the engineer upon his own resources, it is to be regretted, that throughout his examination he did not keep sufficiently in view, and more frequently and specifically point out in his report, the results which would have attended any other mode of treating the section of country, which the line was proposed to traverse; on the contrary, he seems even to have alluded to a deviation from the strict conformity with his instructions only when the nature of the surface rendered it imperative to do so, but wherever a given summit was to be encountered, and it proved to be within the scope of the specified gradients and other conditions, the line was designed in accordance with them, without apparently any, or at most, very little regard being paid to the question of expense, or a consideration of those unforseen contingencies, which works of magnitude, such as those shown upon his section, must inevitably entail, and which have universally occurred within the experience of every engineer." * * * * *

"I have stated that it was difficult to conceive restrictions more calculated to fetter an engineer in such a gigantic task, but it is still more difficult to devise a cause for the French government having originated such regulations; they could not have derived them from any railways in their own country, for both the lines from Paris to Versailles are direct contraventions of them; they could not have deduced them from the Belgian practice, neither could they have formed a basis in the engineering experience in England, for here they would have learnt, that each case was treated as the local circumstances dictated.

"It is true that engineers may and do differ respecting the precise mode of meeting the natural difficulties which may present themselves in the projection of a railway through a long extent of country, and that they differently estimate the comparative advantages and disadvantages of what are termed good and bad gradients; and though I appreciate more highly than the generality of the profession the ultimate benefits which I believe will always be found to spring from the use of favorable gradients, yet I cannot but feel, and that very strongly, that the application of precisely the same principles as those which governed me in designing the London and Birmingham railway to the section of country now under my consideration between Paris, Belgium and the Northern coast, must lead to consequences which the government and every interested individual would hereafter have reason to lament; and I should not be fulfilling my duty as a member of a

scientific profession were I not at once to avow my conviction of the injurious influence of circumscribing the free exercise and application of professional experience within the contracted limits of a code of specified instructions, which, while they fetter design, must entail expense and inconvenience in the execution."

The exorbitant cost to the government for the construction of the lines located upon these principles, is likewise adduced as a reason for their abandonment. Mr. S. however, remarks, that there appears every disposition on the part of the government to entertain a proposal somewhat modified, to meet his views of the case.

Public convenience and accommodation, have influenced the government in ordering an independant station at the point of departure from Paris—as a negotiation with the Messrs. Rothschild failed in consequence of these gentlemen, influenced by their large interest in the Versailles railway, having made it a *sine qua non* that there should be a common station. The same praiseworthy regard for public accommodation, has in several cases, ordered the carrying of the road, even at an increase of length, through some of the more prominent towns and manufacturing districts, and this the report deems favorable rather than otherwise to the interests of the contracting parties as insuring a larger traffic.

The line proposed, after leaving Paris reaches the valley of the Oise at Pontoise and follows it for a distance of 23 miles to Criel where the valley of La Breche, a tributary must be taken. At this point the absurdity of the restrictions above mentioned is shown. Instead of adopting the favorable low ground, the line would be compelled to ascend gradually, occupying the rough sides of the valley and encountering continual difficulties. The report advises an adherence to the low ground and at the summit a grade of about 1 in 150.

At St. Just, the sudden rise in the cliff involves heavy work, upon any plan. The line then descends to near Amiens, and as this town is ordered to be one of the points, a short branch to it is proposed—a population of 60,000 will amply repay this additional expenditure. Between Amiens and Arras on the Scarpe a difficult and elevated country is encountered for 40 miles. Here again the restrictions imposed would have produced a costly and inconvenient location. At Douai a branch to Valenciennes meets one of the Belgian lines, and further on another branch makes another union at Lille. This part of the line and its branches embraces a valuable traffic through a wealthy coal region.

The main line passes over favorable ground nearly along one of the old canals to Calais, a branch is also proposed to Dunkirk.

Mr. Stephenson prefers the line to Calais instead of one to Boulogne, although the passage from Dover to Paris would be about two hours shorter by the latter—but the connection with the Belgian roads and the traffic already existing are more powerful considerations than this saving of time. It is evident that the travel to the Rhine and generally to the whole of the

northern part of the continent would pass over this line, while the whole of the Paris and southern travel will in addition to a vast local business furnish a very handsome return for the investment.

The cost is estimated for the whole distance 255½ English miles.

Excavation, bridging, etc.,	£2,390,598
Land and stations,	1,062,488
Permanent road,	2,124,976
Carrying establishment,	531,244
Total,	£6,109,306

According to the proposal, £3,076,668 of this is to be paid by the company, the remainder by the government.

The investigation of the cost of construction embraces several very useful tables, which at some other time we may again refer to. The consideration of the existing traffic shows an amount of labor very unusual in such documents and although somewhat of local interest is yet valuable as demonstrating the vast importance of railroads leading to great cities and the profitableness of the investment. As one instance of the importance, even of trifles on such a line, we find that the income at present derived from the transportation of *fish* along the proposed route, is over half a million of francs, annually, and for sheep and cattle still more.

We are pleased to find that the views of Mr. Stephenson are so strikingly in favor of the greatest amount of accommodation as conducing to the profit of the capitalist—while the low fare ordered by government, he in some cases proposes to reduce still more.

New York is not so large as Paris, but it *is* a large city and the country around *does* pour in a vast and profitable traffic—but we have yet no New York and Albany railroad to facilitate this traffic or reap the profit.

The following sensible and timely communication will please most of our professional readers by its pungent and yet civil criticism upon a common and shameful disrespect to engineers. We have frequently spoken of the folly of entrusting the management of a completed road to other than professional men; we have also referred to the assumption of engineering duties by directors—together with the bad effects of this amateur engineering. Our correspondent has, however, opened upon another and no less absurd practice and we hope that together with the promised communication upon the Portland road, he will furnish us with more notices to the same purpose.

The conduct of engineers in not asserting their own respectability, in a great measure is the cause of this and similar evils, and any attempts at a reformation are to be considered as promising, if they emanate from engineers themselves.

For the American Railroad Journal, and Mechanics' Magazine.

Messrs. Editors:—As one of the objects of your valuable Journal, is to promote the interests of engineers, a class of professional gentlemen, whose services have been considered important in connection with the construction

of public works, will you allow a few remarks, and extracts, showing how readily directors assume to themselves all of the results of engineering.

The report of the directors of the ***Portland, Saco and Portsmouth railroad***, submitted at the annual meeting of stockholders in June last, happens to be the most convenient case for reference; and firstly, to show in what manner the character of that road is regarded by the directors, observe the language of the following extract:

"The obstacles that have arisen from the sinking of the embankments in some two or three places, to a depth seldom, if ever, before known, and the method taken to obviate, or surmount them, were then, (*in a previous report*) adverted to, with a hope expressed, that the latter might prove successful. That hope has been fully realized. The heavy freshets occurring at the moment when the frost was breaking up, having fully tested them."

And, after showing the nett income for six months, they say—

"This is the produce of five months winter, and one of cold weather. The stockholders may surely look forward to better things. The character of the road, shown in the solidity of the embankments, the strength of the masonry, the design and workmanship of the bridges, the form and weight of the rails and the mode of supporting and connecting them, the length of straight lines, the radii of the curves and the ease of the grades, together with the superiority of the passenger cars, and the efficiency of the locomotives, employed, ought to give satisfaction to the travelling public, whose security and accommodation have been the first objects aimed at in its construction and the manner of conducting it."

These prove that the directors are far from dissatisfied with the road and that they view it as a permanent work, and if it were not for one or two mere allusions to an "engineer department," and to "engineers," in the report, very elaborate and satisfactory as it is on other points, one might suppose that the road came into being by some magical power emanating from the directors. After refering to "various surveys," and to the report of June, '41, they add, "The plan then adopted for the engineering department and the system of accounts then devised * * * have all proved effective and satisfactory;" and again, adverting to certain bills rendered by the contractors they say these "cannot be adjusted until the returns of the engineers have been examined and approved."

And lastly, an important piece of information is given, to wit

"The engineer department has been nearly or quite settled up—some small additions may be required for services in settling the accounts with the contractors."

Perhaps some one can state who these "engineers" were to whom these passages refer, and the writer leaves that question to be answered from other sources—but a few facts, known to him, may serve to show, if not inconsistent with what has preceded, that there are various circumstances connected with the road which reflect a little credit on these "engineers."

The cost of this road when prepared for the probable amount of business, including about **$64,000**, paid stockholders for interest on assessments, will not exceed, "much if any, the original estimate, of about **$23,000** per mile."

The expenditures, to Jan. 1st, '43, were, including interest, $1,107,240·16. The length of the road from the centre of the Piscataqua river, at Portsmouth, N. H., to the depot in Portland, is 50 miles 3093 feet. The surveys were begun January 1st, 1841. The contracts were made for the entire distance on the 1st April following. The topographical examinations and the location, were consequently made within the three worst months of the year. One line was located, passing through York, east of Mount Agamenticus, Wells, Kennebunk, Saco, to Portland, and another, which was subsequently adopted, diverging westerly from the first, at the Piscataqua, and passing through Eliot, South and North Berwick, west of Agamenticus, joining the first named, about 35 miles from Portsmouth. Thus making some 86 miles of actual location, to accomplish which, in a part of the country requiring the most careful surveys, even at the most favorable season for examinations, much time and labor were of course expended on primary lines, exceeding by far, in this as in most cases, the length of the line of location.

In ten months from the letting of the work, 13 miles, and in twenty months, the 50⅗ miles have opened for travel—crossing the deep and rapid Piscataqua, by repairing and improving the old bridge, and connecting, at Portsmouth, with the *Eastern railroad*, thus making a continuous line of road from Boston to Portland, about 104 miles, and on the 14th January, 1843, the engineer department was dissolved by the resignation of the gentlemen of whom it was composed.

There are other points connected with this road which might interest your readers, and in the hope that some one will yet go somewhat into the details, the writer has the more readily passed them by—his object is rather to protest against the unmanly course so prevalent among directors of public works, of hiding as far as possible, any allusions which may let stockholders know to how great an extent they are indebted to engineers, not only for the successful construction of the works in question, but for the very materials of the reports themselves.

ACCIDENTS UPON RAILROADS.

Our last number contained a notice of several recent railroad accidents together with some pretty severe remarks upon the culpability of those who allowed such accidents to occur. One of the editors having received the impression that one of these catastrophies had not been the result of gross carelessness on the part of the company and that many of the articles in the public prints had been written in ignorance of the facts and in a very improper spirit. With this view of the case, a notice was prepared, but during an absence from the city, facts came to the knowledge of the other editor in regard to this and to other accidents, which gave occasion for the article which finally appeared. Since then we have understood that in one of the cases alluded to, erroneous statements were promulgated. We refer to the collision on the Reading railroad, which, it appears, was the result of direct

disobedience of express order, and not to any fault of the company or its superintendant, Mr. G. A. Nicolls. It is but an act of justice to Mr. N. that this correction should be made, for we should feel great regret that any notice in this Journal, directly or indirectly could be construed into an unjust criticism upon the conduct of so worthy and efficient an officer.

No harm has been done, however, by the discussion, which has been the means of eliciting the truth and of opening the eyes of companies and their agents to the necessity of an official organ through which to communicate to the public a correct statement of facts. If we are compelled to draw our information from the newspapers, we of course, must be influenced by the facts as we find them given—but if upon such occasions we receive our account directly from the company—by means of our various exchanges, correct statements can be afforded to the public and with an authority which cannot be given as things are now arranged.

Among the various notices which have appeared, our attention has been drawn to a series of communications in the Baltimore American over the signature T. These seem to us to convey very just views and to embody much information. Extracts from them will be found on another page.

The following extract of a letter from a London correspondent to a friend in this city, will prove interesting.

London, May 19th, 1843.

My Dear Sir:—Thinking you may feel an interest in the report made by the celebrated engineer, Robert Stephenson, on the projected railway from Paris to Lille and Vincennes with a branch to Calais, (the whole distance about 256 miles) I send it to you by the present conveyance. It contains much interesting matter, and I hope will prove of interest to you. I should be glad to hear from you respecting the prospect of your getting on with your magnificent scheme from New York to Albany. It appears to me, this is a work of such paramount importance to the city of New York, since the completion of the whole line of railway from Buffalo to Boston, that sufficient enterprize will be excited to complete it. Let me hear as soon as you can conveniently. I have read many of your statements in the American Railroad Journal, as well as in separate pamphlets, and I am thoroughly convinced that this work if properly made, must be of extraordinary advantage to the community, and of great pecuniary advantage to the proprietors of the stock. A rival work on the shore of the Hudson ought to be deprecated by any well-wisher of the prosperity of New York. Both works cannot be supported, and bringing forward this new scheme will probably prevent either from being made. What is doing with this new project—is it given up, or do you feel any danger from it?

I observe by the newspapers that the legislature of your State has granted new facilities to the New York and Erie railroad company, which will probably enable them to finish this gigantic work. Ought not your concern and this great concern and all others in the United States interested in ma-

king railroads, to unite in trying to get congress to abolish the extravagant duty of $25 per ton, on railway iron? This duty is more than the first cost of flat bar railway iron, and not more than $3½ excess over the first cost of edge rails free on board at Cardriff or Newport! A duty of 100 per cent *ad-valorem* on an article of such importance in promoting the prosperity of our common country, and which cannot be made in America, does not show a very enlightened and patriotic policy in our government. I doubt not if the proper efforts be made that congress at its next session will abolish this unreasonable and impolitic tax.

ACCIDENTS ON RAILROADS.

Messrs. Editors—The frequent accidents on railroads, arising from collisions with cattle upon the track, is imminently perilous to human life, and ought promptly to attract the gravest attention of those in authority. There is, perhaps, no branch of our State police which better demands legislative interference, or which, in all previous attempts to deal with it, has been more misapprehended. In all countries the care and improvement of *highways* are important objects of public concern, and in their management in every well regulated community the convenience and safety of those having occasion to use them are deemed of paramount necessity. It is obvious that railroads have worked essential changes in our system of highways, and that little has yet been done to adapt the laws to the new order of things. * * It is apparent that those immediately engaged in railroad opperations have a deeper interest in their regularity and safety than any one else; for not only are the consequences, in case of accident, vastly more serious to them than to other common carriers; but, besides the risk incurred by the immediate agents, in common with the lives and property committed to their care, the most ordinary accident, arising from any cause whatever, can seldom happen without involving a loss to the company much greater than any amount of their daily profit. Although this should not dispense with the strictest regulations to ensure proper care and precaution from the parties concerned, it may well dispose the legislature to contemplate other sources of danger which due care upon the part of the companies or other agents cannot possibly guard against; and we think the unlimited trespassing of cattle upon the track of a railroad presents a principal source of hazard, for which an adequate provision has not yet been made.

We presume that, according to the universal principles of law, if any one suffer damage from the want of proper care by the agents employed, the companies would be liable. In this State, too, special legislative enactments have been made not only in aid of the charters and of the rule applicable to other carriers, but creating new responsibilities and imposing additional penalties unknown to the common law. It may be hoped, therefore, that as far as the companies are concerned these are sufficient to attain all that the laws can reasonably enforce.

It is understood also that the managers of most, if not all the railroad companies, have co-operated with the law makers in these commendable efforts; that they employ the fullest complement of agents of known sobriety and competent skill, and at the highest rate of wages; and exact the performance of their duties by the strictest contracts and severest penalties. It is believed also that they have at considerable expense established a supervisory force along the line of their roads to keep off cattle and look after other obstructions; and, as far as the curvatures of the road will admit of it, have

placed upon the machinery the best contrivances which have yet been discovered, for the purpose, in case of accident, of protecting as far as possible the passengers and property.

The legislature has shown too that in their opinion something is due from the public to the safety of the lives and property passing over these new description of highways. They have accordingly prohibited all persons from riding on horseback, or riding or driving or leading any horse or horses, mule, oxen, carriage, wagon or other vehicle, or any cattle, sheep, hogs or stock, upon or along any railroad; and "to protect the lives of persons travelling on railroads within this State," they have made it felony in any person to place or cause to be placed on any railroad anything calculated to obstruct, overthrow or divert from the track any car passing on the road with the view or intent to obstruct or overthrow any car, and they have declared that if death ensue from any such obstruction, the person placing or causing it to be placed upon the road shall be guilty of murder. All these provisions, however, relate to intentional offences, or to crimes of such deep atrocity as, it may be hoped, will seldom be committed; leaving wholly unguarded those sources of danger, which though they may proceed from no criminality are of daily occurrence, and not less perilous. To what end, it may be asked, are railroad companies made, as unquestionably they should be, strictly responsible in case there should be any want of care in avoiding obstructions found upon the road, if no means be taken against placing such obstructions upon it, *intentionally* or *otherwise?* The *safety* of the *passenger* requires that *he* should be protected not only against the negligence of the railroad agent in running over an animal on the track, but also against that of the owner who carelessly permitted the animal to be there—and this protection the law should afford him.

The question is not between the railroad companies and the public; nor whether this or that degree of care upon the part of agents of these companies is sufficient; for all that is possible for these to bestow should be and is already exacted with the utmost severity. The real question is, in what manner the safety of the lives and property of the citizens passing over railroads can be best promoted, and by what means those causes most likely to produce mischief may be prevented. * * * *

It is notorious that most accidents upon railroads are produced by collissions and cattle trespassing upon the track; and, from the fact that these casualties are happening upon all roads, in all parts of the Union, and under every system of management, it must be evident that in the nature of the case where the obstruction is found, the collision is inevitable. Who, indeed, can suppose that an engine driver, or other agent, would risk not only his place, but his life, or limb (the latter in his condition important almost as his life) by needlessly running his engine into an animal found on the track?

The rate of speed usually maintained on railroads, and which without such obstructions as we are treating of, may be maintained with greater safety than can be relied upon in the ordinary conveyances (as is satisfactorily shown by the minutest inquiry by a commission institued by the house of commons in England,) is one of the chief purposes of these improvements, and any attempt to limit the speed at a rate at which an engine and train might be suddenly checked would be destructive of these enterprizes, and consequently impracticable. Those acquainted with the operations of a railroad know that at a speed of not more than ten or fifteen miles per hour the progress of an engine attached to a heavy train of cars cannot be arrested even within the space of one hundred yards, and that attempts to do

so often produce a concussion, in itself extremely hazardous. Upon a straight line of road, ordinary obstructions may and ought to be discerned at a sufficient distance to admit of the requisite precaution, and we are not aware of any case of collision that has happened under such circumstances. But in passing curvatures, common to all roads, (often connected with steep grades, requiring such a quantity of steam, both in ascending and descending, as to render it absolutely impossible suddenly to control its power) the obstruction meets the eye of the engine driver too late to enable him by any means whatever to avoid it. It is also well known to every one at all acquainted with the subject that *cows*, especially, seldom or never show any alarm on the approach of the engine; they often get upon the road when least expected almost in contact with the train, and sometimes suddenly emerging from their concealment in the bushes on the side, pass upon the track within a few feet of the locomotive. It must be evident that in all such cases a collision is entirely inevitable; and it may be safely averred that in at least ninety-nine cases out of one hundred accidents from these animals have happened in this manner.

If any question be made upon a point of so much importance to the community at large, the legislature, by instituting an inquiry by means of a commission, as is constantly done for the same purpose by the English parliament, may readily resolve all doubt. The result, I am convinced, will make the case even stronger than I have stated it; and show conclusively that in almost every instance where cattle are run over on a railroad no human precaution could have prevented the collision.

An attempt to fence off a line of railroad from the depredation of cattle is out of the question. Even if it were reasonable to impose such upon the companies, which it manifestly is not, the numerous county roads by which the railways are intersected and crossed would render the attempt wholly impracticable. In this connection it may also be observed that all railroad companies have not only paid the full value of the ground occupied by their works, but in most instances the expense of fencing the contiguous land has been actually included in the damages allowed to the owners.

Now, if it be not in the power of railroad companies, by any degree of care consistent with the business and convenience of the public, to give greater safety to passengers and property, and there yet remain a source of imminent peril to both, should not a remedy be looked for elsewhere? Have not the public the right to demand it? Under such circumstances, we deem it the plain duty of those in authority to look to the origin of the danger, and to apply the remedy to *it*. It arises manifestly from the indifference or carelessness of the owners of cattle in the vicinity of railroads, who, instead of keeping their stock within proper enclosures, turn them out in the morning with a clear knowledge of the fatal mischief they may occasion at any hour of the day; or, what is even less excusable, turn out their herds at night, not only with the same knowledge of the danger they occasion to others but with a much stronger probability that before the dawn of day they may prove the immediate and unavoidable cause of the most fearful destruction of human life! What state of circumstances can justify a longer toleration of such use of a man's property? Should it not require a case of extreme poverty, or other urgent necessity to warrant any man to claim the privilege of supporting his cattle on the public or turning them out to do what mischief they may, at the hazard of such consequences? The just, humane and most effectual remedy, then, would be to prohibit the owners of cattle from allowing them to range at large in the vicinity of railroads, and to require that all cattle in such situations be kept within proper enclo

sures. It is in the full persuasion that no other remedy will prove effectual that I have ventured to trouble you with this paper, I am by no means insensible of the apparent hardships with which such a general regulation may be supposed to bear upon a few indigent persons; though I am not willing to concede that salutary laws of general necessity should be dispensed with because they may give rise to cases of individual hardship. It is not from such cases, however, that the great mischief of which I am treating is to be apprehended. If only the cattle of a few poor persons were allowed to range unrestrained in the vicinity of a long line of railroad the danger would be by no means so imminent, nor the necessity of the particular remedy so urgent. The chief source of mischief arises from the too prevalent and negligent practices of a very different class of our population; who, with ample means to provide for their stock, leave their fields unenclosed, or turn out their cattle upon the commons and in the highways, as reckless of the consequences as if the danger from trespassing upon railroads did not exist. It is by these means that herds of cattle are every where wandering by the line of railways, obstructing the track, and daily occasioning collisions frightful to all, and, in many instances, fatal to many whose business obliges them to use that mode of conveyance.

Now although these practices might have been deemed harmless, and therefore tolerated, in a different state of things, we think it only reasonable that having proved to be of most mischievous tendency under our present system of public improvements, they should now be prohibited and discontinued.

But, Messrs. Editors, I have already extended this article to an inconvenient length, and will close it. My present purpose is accomplished, in calling public attention to an evil of serious magnitude, and indicating what I consider the appropriate remedy. At another time, I may follow up the subject with some further observations calculated to embrace the views here taken.—*Balt. American.* "T."

Railroads in Austria.—An article from a Vienna paper of May 29th, states that the number of workmen employed on the railroads of Austria, was at that time more than 40,000, and that in a short time the number would be increased to 60,000. The railroad from Vienna to Prague will be finished in 1845.

☞ We are indebted to Mr. John A. Roebling for a valuable communication on the subject of Wire Rope, and to Mr. J. I. Shipman for an interesting report of a Railroad Trial. Both of these communications will appear in the next number.

☞ Several returns to our application for Railroad Tariffs will appear also, in our next.

☞ Arrangements have been made for completing a double track on the Pottsville and Philadelphia railroad. Receipts last month $51,000,—Good.

CONTENTS:

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5.

By GEO. C. SCHAEFFER, and D. K. MINOR, Editors.

No. 11, Vol. I. Third Series. | NOVEMBER, 1843. | Whole No. 430. Vol. XVI.

For the American Railroad Journal and Mechanics' Magazine.

AMERICAN MANUFACTURE OF WIRE ROPES FOR INCLINED PLANES, STANDING RIGGING, MINES, TILLERS, ETC. BY JOHN A. ROEBLING, CIVIL ENGINEER.

The art of manufacturing ropes of *wire* is comparatively new. Numerous attempts have been made in Europe and here, and most of them have proved failures. A collection of parallel wires, bound together by wrappings in the manner of a suspension cable, is no rope and not fit for running, it can only be used for a stationary purpose. The first rigging made in England, was of this description. The difficulty in the formation of wire rope arises from the unyielding nature of the material; iron fibres cannot be twisted like hemp, cotton or wollen; their texture would be injured by the attempt. To remove this obstacle, some manufacturers have resorted to *annealing*, and thereby destroyed the most valuable properties of iron wire, viz. its great strength and elasticity.

My first attempts in the manufacture of wire rope, were made four years ago, my intimacy with the construction of wire cable bridges induced me to investigate this matter. The principles of my process differ from those of the English manufacturers, they are original and secured by patent. The novelty of my proceeding chiefly consists in the spiral laying of the wires around a common axis *without twisting the fibres*, and secondly in subjecting the individual wires while thus laying to a uniform and forcible tension under all circumstances. By this method, the greatest strength is obtained by the least amount of material, and at the same time a high degree of pliability. Each individual wire occupies exactly the same position

NOTE.—By the term elasticity, I mean the property of wire to stretch and give when subjected to a strain, and to resume its former length after the strain ceases, without suffering a permanent elongation. The extent of elongation of iron is in proportion to the tension. In estimating the strength of a rope, the strain it has to support, should never exceed the limit of elasticity. A permanent strain requires some more allowance.

The elongation of good wire of No. 14, 15 or 16, amounts, according to my own experiments to $\frac{1}{5000}$ of its length per ton per square inch. A strain of 15 tons upon a rope of 1 square inch section and 1000 feet long will produce an elongation of 3 feet. The limit of elasticity for working rope I have assumed at 15 to 20 tons per square inch, according to the size and quality of the wire. A greater strain will produce permanent elongation, and if repeated, at last a rupture.

throughout the length of a strand; another result of the precision and force applied in laying, is the close contact of the wires, which renders the admission of air and moisture impossible.

Three years ago I offered to the board of canal commissioners which was then in power in Pennsylvania, to put a wire rope of my manufacture on one of the planes of the Allegheny Portage railroad, at my own risk and expense, the value of the rope to be paid in proportion, as it rendered services equivalent to a hemp rope. This liberal offer however was rejected and not considered until the present board came into office. Last year I put three ropes, measuring in the aggregate 3400 feet, 4½ inches circumference, in operation on plane No. 3. Owing to the want of adhesion, I had at the start to contend with some difficulties. By means of a double groove on the receiving sheave and a guide sheave placed back of it, which crosses the rope and leads it from one groove to the other, which improvements were added to the machinery last winter; I succeeded in doubling the adhesion. When in unfavorable weather there is delay and slipping on the other planes the wire rope can at all times pull as heavy a load *without* a balance, as the engine is capable of hauling. The planes of the Portage railroad require hemp ropes of 8½ inches circumference, made of the best Russia or Italian hemp, and which cannot be trusted longer with safety than one season. They are frequently from reasons of economy continued 1¼ seasons; much however, depends upon the weather and business. The unfavorable circumstances under which the wire rope had to work last year, effected it some; the wear of the whole of this ssason, however, is not perceptible, and its present condition promises a long duration. I am now manufacturing another wire rope of 5100 feet long in four pieces for plane No. 10.

The first rope of my make, 600 feet long, 3¼ inches circumference has now been in successful operation two seasons, hauling section boats from the basin to the railroad at Johnstown. Two more were put to work last spring at the new slips at Hallidaysburg and Columbia. From my present experience, I may safely assert that *wire rope* deserves the preference over *hemp rope* in all situations much exposed; and where great strength and durability is required.

By my process of manufacture, the same pliability is imparted to the rope which is proper to the wire itself. Paradox as this may appear, it is nevertheless a fact and is easily explained. By pliability is here understood the extent of flexure to which the rope or wire may be subjected, without producing a permanent bend; when released the rope must resume its former and straight position. To bend a rope requires force, and this force is in proportion to its areal section, *caeteris paribus.*

Well manufactured *iron rope* is *more* pliable than *hemp rope* of the same strength. I am manufacturing tillers of fine wire, capable of bearing 3000 lbs. and which ply around cylinders as small as four inches in diameter, and in which the wires are so compactly laid, that not the slightest shifting in their spiral position is to be observed. A number of my tillers are in use

on the Ohio and Mississippi. Such rope would be pliable enough for running rigging and be of long duration.

I will here add a few remarks on the introduction of *standing wire rigging* in place of *hemp rigging.* This subject has for some years passed, engaged the attention of the navy department of England and France, and the success which has attended the use of wire in place of hemp for shrouds and stays in the naval and commercial service of Great Britain, would, it appears, seem to warrant an attempt to test its utility on our national vessels.

Allow me to cite here a few remarks from the notes of Capt. Basil Hall, on a tour through Switzerland, and while examining the wire suspension bridge at Fryburg. He says, "attempts are now making and will ere long succeed, to introduce wire rigging, which is stronger and better than *chain*, because less dependent on the accidental quality and careless manufacture of a single part. How strange it is, that the plan of making *wire bridges*, so successfully adopted in France, and elsewhere, should not have found favor enough in England to be fairly tried on a large scale. Fryburg bridge 301 feet *wider* than Menai, at least equally strong, has cost only one-fifth of the money. I do not think wire will answer for running rope; but for standing rigging it may, I conceive, be most usefully substituted for hemp, for with equal strength experience shows it to be lighter."

The cables of suspension bridges are stationary and will, when protected against oxidation, last an indefinite period. Standing rigging, (when compared to running rope) is nearly stationary, and there is little wear but what arises from the direct strain, which if supported by sufficient strength, will have no deteriorating effect. In comparing the two materials, wire and hemp for rigging, the state of preservation and time of use should be considered. For instance, a hemp stay of a certain size, made of the best Italian hemp, will when new, possess two-thirds of the strength of a wire stay of the same weight per foot; but let the two stays have been exposed and served five years, then the strength of the hemp stay will be gone, while the wire stay will not show any perceptible reduction. In this case, of course, a common wear and tear is supposed.

The most prominent features of wire rigging as compared to hemp rigging, are its great durability, less weight and size, less surface exposed to wind, less danger in time of action of being destroyed by shot. Another good quality of the wire rope is its great elasticity which is quite sufficient to counteract the effect of a sudden jerk, while a vessel is rolling heavily at sea. The elasticity of hemp rigging is only to be relied on to a very small extent, it will give and stretch a great deal but not return.

A common objection of those not familiar with the nature of wire rope, is its supposed rapid destruction by oxidation, but no apprehension is less founded than this. Running wire rope while in use either in or out of water, in mines or any other situation, will not even require the protection of oil, varnish or tar; while at work it will rust no more than a rail or a chain in use, but when idle, oxidation will affect it in proportion to the surface expo-

sed. As, however, the process of laying is carried on with mathematical precision, by which the wires are brought into the closest contact, the assemblage of wires in form of a strand, present a solid rod, which will be no more subjected to rusting than the link of a chain of the same size. The individual wires as well as the strands and ropes are coated with an excellent varnish during the manufacture. Wire rigging will require no other protection but oiling or tarring once or twice a season. Where elegance is an object, black or green paint may be used. Rigging made of zinked wires and not painted, would present a most elegant appearance and be exempt from all rusting.

Wire rope can be spliced in the same manner as hemp rope. The attachment of wire shrouds to the sides of the vessel and to the masthead and their connection with the rattlines (which should also be of wire) can be effected by the old method; the use of wire however, will suggest some modifications better adapted to the material.

Some wire rigging has been manufactured in England which simply consists of a collection of parallel wires bound together and served over with hemp. These mixtures, as experience has proved in the case of tiller-ropes, are objectionable, the wire will rust inside of the hemp in spite of all protection by varnish; besides the cover of hemp, which adds nothing to the strength, is only an additional expense.

Iron is now gradually superseding wood in the construction of vessels, a complete revolution in ship building has already commenced in England. Although very expensive at first, iron ships will prove the cheapest in the end. Are there any well founded objections to wire rigging, which assumes the same relation to hemp rigging as wooden ships to iron ones? There are none. Why then not test this matter by encouraging those who are capable of bringing it to perfection? A number of iron vessels are now building for the naval and revenue service, which seem to offer appropriate occasions for the test of this matter.

Saxonburg, Pa., Sept. 1843.

ACCIDENTS UPON RAILROADS.

Messrs. Editors:—In a previous paper I adverted to the essential change worked in the system of highway police by the introduction of railroads, and the application of steam power to vehicles on land; and pointed out the necessity of correspondent regulations for the safety and protection of such as have occasion to use these new improvements. I think the subject cannot be too earnestly pressed upon the attention of those who have the power and whose duty it consequently is to deal with it.

It is foreign from my present purpose to advert to the ultimate effect which the new and wonderful power now in successful operation is destined to produce upon all the relations of trade and of society at large; but it may well be supposed that the suddenness with which the invention came upon the public, and the extraordinary results that immediately attended it, prevented the proper attention to the means more particularly calculated to insure safety in its practical operation.

In the prosecution of these improvements the United States and England

took the lead; and though in both countries the common high road was rapidly superseded by an agent of such vast power for good or ill, some time elapsed before the authorities of either appeared aware of the necessity of appropriate regulations adapted to this new species of communication. This branch of the subject first attracted the attention of the government in England.

In the year 1838 the reports of "commissioners appointed to consider and recommend a general system of railways for Ireland," was presented by the command of the Queen, to both houses of parliament; and in these the dangers of railroad travelling, as compared with that on the common highway, and also the means which had already been provided against the former, are particularly considered.

The reports were subjected to the fullest discussion by some of the ablest writers in England, and I cannot do better than devote the most of this article to a quotation from one of the best papers to which the investigation gave rise. The reader will be thereby better enabled to appreciate the observations I have already submitted, and those which I may hereafter make.

It will be perceived from the facts stated in the quotation, that the rigorous exclusion of cattle from the track is part of the means resorted to in England to guard against the dangers upon railroads, and that to this precaution the extraordinary safety which has attended them may be mainly attributed.

The writer is treating of those parts of the reports relating to the dangers attendant upon the old and new description of roads, and, after many pertinent observations upon the advantages of the extraordinary velocity with which passengers and heavy goods are transported upon railroads, he proceeds as follows:

"The dangers of travelling in either fashion may be divided into four heads, namely:

1. The dangers of the road.
2. The dangers of the carriage.
3. The dangers of the locomotive power.
4. The dangers arising from momentum, or from the weight of burden, multiplied by the velocity at which it is conveyed.

"As regards the first of these, we are certainly humbly of opinion that *cæteris paribus*, a railway must be less dangerous than a high road; because it is flat instead of hilly; because a surface of iron is smoother than a surface even of broken stones; because the lip of the rail which confines the wheels is an extra security which the common road does not possess; and because wagons, vans, carts, private carriages, and all other vehicles, *as well as horses and cattle, belonging to the public, are rigorously excluded.*

"As regards the second of these dangers, we submit to our readers that *cæteris paribus*, a railway car must be less dangerous than a stage or mail coach, because its centre of gravity, when empty, is low instead of high; because its passengers sit low instead of high, inside and not outside—because its axles, receiving no jerks, are less liable to break—and consequently because altogether it is less liable to overset.

"As regards the third of these dangers, we conceive there can be no doubt whatever, that, *cæteris paribus*, a locomotive engine must be less dangerous than four horses, because it is not liable to run away, tumble down, or shy at strange objects or noises—because it has no vice in it—because it is not, like a horse, retained and guided by numberless straps and buckles, the breaking of any one of which would make it take fright. And lastly, because, by the opening of a valve, its restless enterprizing spirit can, at any

moment, be turned adrift, leaving nothing behind it but a dull, harmless, empty copper vessel.

"It is true that it is possible for the boiler to explode, yet as the safety-valve is the line of least resistance, that accident with mathematical certainty can be so easily provided against, that it is not now apprehended; and even if, contrary to philosophical calculations, it should happen, the sudden annihilation of the locomotive power would injure scarcely any but those firemen or engine drivers answerable to the public for their neglect which had occasioned the misfortune, while to the great bulk of the passengers, it would create no inconvenience except a gradual halt of the train.

"With respect to the fourth of these dangers, it must be admitted, that both the speed and weight of a railway train are infinitely greater than the momentum of a mail or stage coach; yet, if the latter, in case of serious accidents, be sufficient to cause the death of the passengers, it might be suggested that the former can do no more; just as it is practically argued by old soldiers, when they rebuke recruits for dreading artillery, that a musket ball kills a man as dead as a cannon shot. If a railway train, at full speed were to run against the solid brick work of the tunnel, or to go over one of the steep embankments, the effect would mechanically be infinitely greater, but perhaps not more fatal to the passengers, than if the mail at its common pace, were to do the same; besides which, it must always be remembered, that though the stage may profess to travel at the safe lukewarm pace of eight miles an hour, yet any accident suddenly accelerates or boils up its speed to that of the railroad, under which circumstance the carriage is ungovernable. In going down a hill, if a link of the pole-chain break—if the reins snap—or if the tongue of a little buckle bends, the scared cattle run away—and it is this catastrophe, it is the latent passion, and not the ordinary appearance of the horses, which should be fairly considered, when a comparison is made between railroad and common road travelling; for surely there is infinitely less danger in riding a horse that obeys the bridle at twenty miles an hour, than there is sitting demurely trotting, at the rate of eight miles an hour, on a runaway brute that is only waiting for the shade of the shadow of an excuse to place his rider in a predicament almost as unenviable as Mazeppa's.

"There is nothing, we understand, at all either dangerous or disagreeable in going what is vulgarly termed "fast," if no object intervenes mechanically to oppose the progress. Now we have already shown that the obstructions which exist on a railroad are infinitely less than those which exist on a high road, inasmuch as from the former *every human being, animal and vehicle is excluded, excepting those safely included in the train.*

"So much for theory; in practice the precise amount of the danger of railroad travelling, even at the commencement of the experiment, will at once appear, from the following official reports, to have been about *ten passengers* killed out of more than *forty-four millions!* [See opposite page.]

Now, in England the average speed upon railroads is at least thirty miles per hour, and from the feregoing observations we think every one will be struck with the miraculous safety with which, with such an extraordinary degree of velocity, railroads have transported so many millions of human beings! When the reader reflects that this safety is chiefly attributable to those rigorous measures by which cattle—the most common cause of obstruction—are excluded from the English roads, he will be apt to inquire whether similar preventives be not equally called for, and should not be adopted in this country.—*Balt. American.* T.

Names of railways.	Date. From	To	Number of miles.	Number of passengers.	Number of accidents.
London and Birmingham,	July 20, 1837,	Nov. 5, 1838,	19,119,465	541,360	3 cases of contusion, no death, (1.)
Grand Junction,	July 4, 1837,	June 10, 1838,		214,064	2 cases of slight do. do. (2.)
Bolton and Leigh and Kenyon and Leigh,	June 13, 1831,	October 1, 1838,	3,923,012	508,763	2 deaths, 3 slight contusions, (3.)
Newcastle and Carlisle,	March 9, 1835,	October 1, 1838,		8,540,759	5 deaths, 4 fractures, (4.)
Edinburgh and Dalkeith,	Summer of 1832,	Sept. 30, 1838,		1,557,642	1 arm broken, (5.)
Stockton and Darlington,	October 10, 1832,	October 10, 1838,	2,213,681	357,205	None.
Great Western,	June 4, 1838,	Nov. —, 1838,	4,109,538	230,408	None.
Liverpool and Manchester,	Sept. 10, 1830,	Sept. 28, 1838,		3,524,820	8 deaths, no fractures, (6.)
Dublin and Kingston,	Nov. 14, 1836,	Sept. 1, 1838,		26,410,152	5 deaths and 3 contusions to passengers.
London and Greenwich,	Dec. 14, 1836,	Nov. 5, 1838,	484,000	2,880,417	1 passenger slightly bruised.

1. None of these accidents occurred to actual passengers.
2. None of these accidents occurred to actual passengers.
3. None of the persons killed were passengers.
4. One of the persons killed was a passenger.
6. The whole of these were passengers; one of them, a sergeant in charge of a deserter, who jumped off the carriage while in motion. The serjeant jumped after him to retake him, but was so much injured that he died; 3 others got out and walked on the road, and were killed; the rest suffered by collision of two trains, at different times. These include all the casualties from the very commencement of the working of the line."

Railway and Common road Travelling.—The Paris papers contain advertisements of diligences which leave Paris daily for the southwestern parts of France—Tours, Bordeaux, etc., by the Orleans railway. These diligences proceed upon the railway to Orleans, a distance of about 80 miles, and on their arrival are immediately transferred, without unloading of either passengers or baggage, to wheels and vehicles drawn by horses ready harnessed, and the journey is continued upon the common roads. On the arrival of these vehicles at the railroad from the south they are separated from the wheels, and without any disturbance of the passengers are transferred to the truck provided for it, and attached to the locomotive train, and the journey is thus continued to its termination. To facilitate this operation a machine for transferring the carriage from one set of wheels to

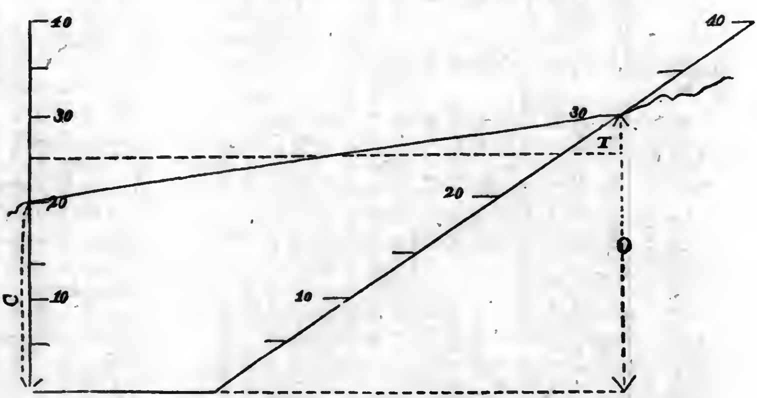
the other has been invented by M. Arnoux, which was first introduced, and as we learn with entire success, on the Orleans railway on the 10th June. The number of passengers on the line of the Orleans railroad in the month of June was 50,329, and the amount received for passengers, post chaises, horses, merchandize, etc., was 320,417 francs. On the same railroad to Corbeil, in addition to those on the Orleans line, the number of passengers in June was 74,420, receipts from all sources 114,505 francs; total of passengers in the month 124,749; receipts 434,922 francs.

NOTES ON PRACTICAL ENGINEERING.—NO. 2.

Cubical Quantities.

In preliminary surveys the object is to determine from the levels of the centre line the quantities of excavation and embankment to such a degree of accuracy, as to give a fair view of the absolute cost and also of the relative merits of the rival lines. Where there is no transverse slope the degree of accuracy is limited only by the number of levels in a given distance and the calculation is as easy and expeditious as can be desired.

When the ground slopes transversely, the inclination is taken by the level and rod or by the slope instrument. In the great majority of cases the latter will be the more convenient method. Having the centre levels and the slope on each side, we are prepared to calculate the cubic content, on the assumption that the surface of the ground is even from the centre to the point where the cutting or embankment runs out. It is not intended here to examine the merits of various modes of finding these quantities, whether by tables or by a graphical process, but to suggest a combination of the two which appears to offer some advantages in hill-side work.



Draw a half section of cutting, as in the wood cut, to a scale of about half an inch to the foot, on which the divisions at centre and on the slope may be distinctly marked to tenths of a foot; though two tenths would be near enough in practice. If the inclination be taken in degrees, then with a protractor and with a thread at the given angle over the centre cutting we have the point where the slope cuts the surface of the ground and of course

the depth O. The half sum of these depths in a table of level cutting will give a quantity too great by a triangular prism T, having its altitude equal to $\frac{1}{2}$(O—C) and for its base $\frac{1}{2}$(O—C)r.

Example. Depth of cutting at centre 20 feet, half width of base 20 feet, slope $1\frac{1}{2}$ to 1 and depth at outside stake determined as above, 30 feet; required the cubic content per 100 feet.

(20+30) per table of level cutting $= 3{,}588$ cub. yds. per ch.
(30—20) per Mr. Johnson's table of prisms $= \quad 69{\cdot}4$

Content $= 3{,}518{\cdot}6$ cub. yds. per. ch.

omitting the correction for longitudinal slope as is usual in preliminary surveys. This plan of approximating the cubical contents requires, in addition to the ordinary tables, merely a table of triangular prisms and a half section of cutting and embankment. For the latter it is only requisite to erect a perpendicular at the proper point between the centre of cutting and the slope, when the slopes are equal; if unequal a separate diagram may be used.

In place of taking the transverse inclination of the ground in degrees it may be taken in "feet rise" in a given distance—say the half width of roadway—then the following plan may be adopted.

Mark on the vertical line of centre cutting not only the depths, but also the cubic yards per chain due to those depths and draw horizontal lines from the centre to the slope at each division. Then the centre cutting and rise in half breadth being given, place the edge of a graduated rule on these two points—the zero over the centre cutting. The point where the edge of the rule crosses the slope determines of course, the height O; the half distance between these points will be on the horizontal line on which is marked the cubic content per chain due to a depth $= \frac{1}{2}$(C+O). The divisions on the edge of the rule will give this half distance at a glance, and, to prevent confusion, the horizontal lines may be drawn in different colors. This quantity will therefore be called off by inspection. The correction may be determined in a similar manner. Graduate the edge of a short rule to the same scale as the line of centre cutting, but mark on the divisions the cubic yards per chain contained in triangular prisms of which these divisions represent the altitudes. Then, placing the zero of this rule at the centre cutting, the division where the horizontal line, determined above, crosses the edge of this rule will give the correction also by inspection.

It frequently happens that the choice lies among a number of lines connecting the same points and not materially differing in the quantity of earthwork. In such cases a close approximation to the actual quantity is necessary, and the calculations become laborious. It is for the reader to decide whether the methods suggested in these notes compare favorably or otherwise with his own practice. If the latter, he will perhaps make his views known through the columns of the Journal.

The following table may be useful in some cases of earth-work and masonry. It gives the correction per cent. to be deducted from the average of the bases of frustrums of pyramids or, which is the same thing, from the

half sum of the solid contents of two triangular prisms erected on these bases. Suppose D and d to represent the end areas of a frustrum of a pyramid whose altitude is 1, then the solid content will be $\frac{1}{3}(D+d+\sqrt{Dd})$; but by averaging the end areas it will be $\frac{1}{2}(D+d)$. Table II gives the deduction per cent. to be made from $\frac{1}{2}(D+d)$ to give the true content.

TABLE II.

$$\left\{\frac{D+d}{2}-\frac{D+d+\sqrt{Dd}}{3}\right\}\frac{100}{\frac{1}{2}(D+d)}$$

	D								
d	2	3	4	5	6	7	8	9	10
1	1·90	4·46	6·67	8·49	10·0	11·28	12·40	13·33	14·15
2		·67	1·90	3·22	4·46	5·62	6·67	7·62	8·49
3			·34	1·06	1·90	2·78	3·64	4·46	5·23
4				·20	·67	1·26	1·90	2·56	3·22
5					·14	·46	·90	1·39	1·90
6						·10	·34	·67	1·06
7							·07	·26	·52
8								·06	·20
9									·05

W. R. C.

THE LONG ISLAND RAILROAD COMPANY *vs.* LUTHER LOPER.

This was a resort of the L. I. railroad company, to the legal course in case of a disagreement as to the value of property taken for the use of the company. On application to the vice chancellor, three appraisers were named and accepted by the parties, notices were issued and a day appointed by the appraisers to view the premises and hear such evidence as the parties might choose to offer in reference to value, damage, etc. The appraisers met according to appointment, and the parties appeared with their witnesses, J. R. Lott, Esq. being counsel for Loper, and the company being represented by their president and two directors.

The president of the company offered the map and profile of the ground taken, and the appraisers proceeded to view the land as staked out. The counsel for Mr. Loper then claimed that his client was entitled to receive, 1st, the full value of the land, stated to be $75 per acre, and 2d, a sufficient sum of money to build and maintain a fence on each side of the road for the duration of the charter, and a further compensation for the grain and grass destroyed in the construction of the road. To establish his position several witnesses were called, who testified that the whole farm taken together was worth $50 per acre; that the portion taken for the railroad was worth $60 per acre where the ground was cleared, and $10 per acre where covered with wood; one witness considered the railroad a damage to the farm, and another that it was worth about as much as before, and that the fencing was worth seven shillings [87½ cents] per panel of 12 feet. The testimony of other witnesses on the same side to the same facts was also taken, and the counsel here rested his case.

The president then opened the case on the part of the company, by giving a general statement of the business and condition of the road with a view of showing its operation upon the interests of the landholders, which he claimed was in every case beneficial; he submitted to the commission whether it was just that a party benefitted to the amount of some hundreds of dollars should come forward and claim of the party conferring the favor, a large sum because he himself was not quite so much benefitted as his neighbor through whose land the line did not happen to be located; he could not persuade himself that the commission would be willing to adopt the principle that because some of Mr. Loper's neighbors were benefitted $1000 and Mr. Loper but $500 that therefore the company should pay him, Loper, the difference. And finally, on the part of the company the ground was taken, that the spirit as well as the letter of the statute, required the commission to consider whether the whole farm was worth more or less by the occupation of a portion of it by their road, and he contended that in case he could show as he hoped to do, to the satisfaction of the commission that the land was actually more valuable than before, they were bound to adjudge that there was no damage done; that the term compensation used in the charter could not by a fair construction be limited to a payment in money, but embraced all the advantages in any way connected with the road and that any rise in the value of the property was actually a compensation for the damage as if the same amount was actually paid in money, or any facility in transportation of produce or manure or saving in time, were actually a portion of the compensation required by the statute. In support of this position he cites several cases where railroads, turnpikes and common roads had been established on the same ground, and also the universal custom in cities of assessing benefits and advantages as well as allowing for damages when they occurred, and he contended that these were all parallel cases except that the company's charter gave them no privilege as to the assessment of benefits on those whose lands were not immediately occupied by the company, and confined tham solely to the question of damage. He considered it a monstrous perversion of law as well as of common sense to allow a man to be entitled to damage, when the property in question was actually increased in value 50 per cent. by the very parties to whom damage was attempted to be charged. Witnesses were then called who reside along the line of road, to show the advantages they derived from the road in their farming operations, but their evidence was objected to as irrelevant, and witnesses were then called to show what had been the value of the land previous to the location of the road. They testified that Loper gave about $30 per acre for the farm with good buildings, that the ordinary price for cleared land was $20 to $25 per acre, and for wooded land $2 to $5, and several witnesses testified that they considered his land worth from $300 to $400 more on account of the facility of sending his produce, wood, etc., to market, and obtaining a return of manure at the company's prices.

In reference to the fencing, it was contended on the part of the company,

that cattle guards at the cross fences were sufficient, and that no fences were needed to make the road safe; a model of the guards used on the road was exhibited and several witnesses examined as to their effect in protecting the landowner, and here the testimony on the part of the company closed.

The counsel for Loper in reply denied the position that the benefits conferred were to be at all considered, and contended that the legislature had in every case where such a course was intended introduced a specific clause to that effect; that the commission were bound to consider the damage only, without reference to any prospective benefit; that the term compensation signified a payment of a specific sum of money and that any other definition was inconsistent with its usual meaning and with the decisions of the courts in similar cases. He contended that the admission of the principle of offset in these cases would be opening a wide door for all kinds of speculative enterprizes, and that the commission were bound to repudiate such a construction of the law, in justice to the community as well as Mr. Loper. That the similarity supposed in this case to that of city corporations did not exist, and that the omission in the charter to specify the assessment of benefits on other than the owners of lands occupied by the company was sufficient to show that such was not their intention in reference to the owner himself for it would result in great injustice if one man was to be taxed for the benefit of his neighbors and that too, without his consent, while they enjoyed the advantages without contributing a farthing; and finally he cited several cases from Wendal's reports, particularly that of the Mohawk and Hudson railroad company *vs.* Bloodgood, to show the law in reference to fencing, declaring that although he supposed the cattle guards might be some security he considered a fence necessary to the perfect security of the landholder.

The commission decided that the land was worth $10·25 per acre, and that Mr. Loper if he chose to erect a fence on one side through his cleared land should have 70 cents per panel of 12 feet for making and maintaining the same.

NOTE.—Since the above case the vice chancellor, in a case reported for and printed in this Journal, decided that no fences were necessary. See Long Island railroad company vs. A. M'Conochie. I have given a sketch of the proceedings because they present what I conceive to be the true ground to be taken in similar cases where amounts are claimed from companies under the name of damages, which should rather be termed a fine for conferring benefits, inasmuch as the amount claimed is generally in exact proportion to the advantages conferred. I believe that the commissioners of public works in most of the United States adopt the principle of offset is estimating damages and I cannot see why the principle should not be followed out in similar cases.

Tolls and Trade of the Canals.—The amount of flour and wheat arrived at the Albany office during the 2d week in October, was flour 57,838 bbls., wheat, 5,674 bush. Making an aggregate of 58,970 barrels. The amount of merchandize cleared from this office during the same time amounted to 2,998,100 lbs.

Tolls during the same week, amounted to $8,953 52. There is a slight falling off in the receipts of tolls and the shipments of merchandize from the first week, but the arrivals of flour exceed those of the first week in October, by 3,946 barrels.—*Albany Argus.*

Being a party referred to in the communication of Mr. Latrobe, propriety forbids that we should say more, at present than that we commend it to the earnest attention of our readers as containing the outlines of a plan which appears to be in some form or other regarded by most of the Profession as the only feasible and acceptable mode of producing a union of the Profession of Civil Engineers.

For the American Railroad Journal and Mechanics' Magazine.

It is known to most of the Profession throughout the United States, that in the year 1839, an attempt was made to establish "an American Society of Civil Engineers." A convention, having this object in view, assembled at Baltimore in February of that year, and the measures then adopted seemed as conducive to the end proposed as could have been devised, and were carried faithfully into effect by the officers entrusted with their execution. The project, however, failed, as had been predicted by those unfriendly or indifferent to it, and feared by its advocates and supporters. The causes of the failure were obviously to be seen—in the wide space over which the members of the institution would have been scattered, rendering their meetings inconvenient and expensive—in the sectional feeling attendant upon the division of the country by the boundaries of distinct States, each having its own capital and uniting its own body of Engineers by a local esprit de corps; and again in the difficulty of satisfactorily adjusting the appointments to office in the organization and government of the society.

The attempt to establish a *National* society having thus failed under circumstances which discouraged its repetition, it may have occurred to some that each State might have a distinct society for itself, or that several contiguous States might unite in the formation of one; thus, in the latter case, dividing the Union into groups of States for the purpose. To the first of these plans the objection is that only a few of the larger States are likely ever to possess, at one time, within their limits a sufficient number of Civil Engineers to support such an institution; and that in the composition of this limited number, changes will be frequent, owing to the constant emigration of the members from one State to another. The same difficulty exists though in a less degree in the partial confederation of neighboring States; and indeed it is manifest that any extent of territory less than the whole country must contract the jurisdiction of such an institution, very much to the disadvantage of the objects it is designed to promote. If independant or associated State societies were however formed and found to operate well within their own boundaries, there must still be some means employed to connect their separate action, so as to maintain a mutual intercommunication between them, in order that the individual proceedings of each might enure to the common benefit of the whole—and this federative connection would be as essential to the advancement of their common objects, as our general government is to the promotion of the general welfare of the republic of which we are the citizens. This correspondence between the State societies would, for the most part be epistolary, and carried on through their officers; for, the

members at large of the several bodies could no better afford to mingle interchangeably in the meetings of their respective assemblies, than they could come together in the general convention of a National Institute—and intercourse could not be kept up by *delegations*, either with convenience to the deputies or general advantage to their constituents. So then, it would appear that pen, ink, paper and the mails must, at last, be the grand medium of communication among the Profession. Why, then, not take to it at once without a resort to societies difficult to form, expensive to maintain and after all inefficient in their operation?

To the abortive plan of one or more "societies," this interogation presents, as the conclusion following the preceding premises, a very obvious alternative, and one which the Profession has been all along practically employing. Engineers who want information from each other and cannot get it by talking, do it by writing. The improvement by which this most familiar mode of intercommunication is susceptible, and which it is much in need of, is a more general diffusion of its advantages by the introduction of that *system* without which nothing of an associative character can flourish. And of what should this system consist? Of nothing more than this; that a reservoir should be provided into which by the conduits already existing in the mails of the country, every individual of the Profession who has so much as a drop of professional knowledge, may cause it to flow; or, in plain terms, that a Journal should be established as the general organ of the fraternity, to which every one of its members should regard it an imperative duty to contribute paragraphs or pages as his ability and opportunities may permit.

Now there are already several publications founded and maintained for this very object; so that this part of the scheme is no more new than the other, and all that I pretend to, is to point out the capability of this plain, cheap, and long though imperfectly used mode of correspondence to effect nearly all that such a society as was originally contemplated could have accomplished. If I succeed in this I shall, it is true, deserve no more credit than Dr. Franklin merited, when he proved to the Parisians that the sun rose at such an hour and gave light as soon as he was up—but with this I shall be satisfied if the consequences of the demonstration be what I desire.

That an epistolary association of Engineers may become an efficient means of professional intercourse, the following requisites are indispensible.

There, first of all, must be aroused and kept alive in its members, an ardent desire for the advancement of the interests of the Profession in the acquisition and diffusion of science, experience and skill: an active esprit de corps in our ranks, leading to strenuous and united efforts to raise our character as a liberal profession *in our relations to the other professions.* A generous emulation among ourselves individually, entirely free from bitter personal rivalry. The suppression of a hypercritical temper in regard to the *literary* merits of the articles which may appear in our Journal, the substantial information conveyed being looked at *through* the style of its communication

however inelegant that may be, always provided it be sufficiently perspicuous. The best practical Engineers are not always the best writers, and as there is so much of the *mechanical* in our pursuits, we should encourage free communications from those whose calling is entirely of that kind; but who might, if their compositions were too severely criticised, be deterred from giving us the benefit of their knowledge.

To keep under the sensitiveness to be found fault with, which leads to so much personal retort and acrimony in the discussions which figure in professional Journals. We should not wince at criticism however condemnatory, provided it be fair and free from an unkind and caustic spirit.

Sectional and State jealousies, which we all know to have heretofore excited in no inconsiderable degree, must be suppressed, and the whole United States be regarded as our common country. The promotion of national feeling is of prime importance to our object, as it disposes one State to borrow more freely from another whatever may be found of superior merit.

A spirit of frank inquiry into the practice of others, in regard to modes of construction of works and their management, should be promoted; so that no Engineer who has a work to do, or a system of management of a finished work to organize should fail to acquaint himself with the methods used by others in analogous cases. The ambition to be different from all others in our way of doing things is too prevalent. It is a spirit more pardonable than wise; but as it will continue to possess us, the way to gratify it and secure originality in our own productions, is to know all that others have done before us in that department.

Untiring *industry* in collecting and communicating every species of professional information within our reach. We should avail of every opportunity of noting down the facts falling in our way (however comparatively trivial) bearing upon professional principles. These observations should be transmitted to the Journal at our earliest leisure. And in regard to this most meaning word *leisure*, it is necessary that right ideas should be entertained, as wrong ones are so prevalent. The Engineer who waits for entire cessation from professional occupation and care to record his experience for the benefit of others will wait in vain, and do nothing for them after all. Leisure will never come to him even if employment should cease. That suspension of labor generally brings with it a loss of active interest in the concerns of the profession, and the procrastination which prompts him to postpone until an idle hour, his note or his contribution to the Journal founded upon it, will in a majority of cases put off the making of it altogether. The undersigned frankly avows that he speaks in this matter from personal experience.

The Engineer should not wait until he actually and immediately wants information upon certain points; but if anything should occur to make him sensible of the advantage of eliciting, for the common benefit, the experience which may exist in regard to such points, he should at once pro pound in writing a series of queries, and forward them to the Journal, ad

dressed to the Profession at large, and calling for answers, which should be promptly given by those who can furnish them.

The information thus asked for should be as *detailed* as possible—vague and general accounts of works are mostly unsatisfactory and of no practical utility. We want to be saved the labor of studying out for ourselves what has been already and successfully carried into effect by others, so that, in all that we do to advance the art of Engineering, our first step may be planted in the last foot print of him who preceded us, and has gone on that track as far as his own purposes required. A vast deal of sterling talent and precious time is thrown away in re-inventing what has been already invented and applied, if we did but know it—and a vast deal of mortification is felt in finding that what we had worked so hard to secure as our own should after all belong to some professional brother who had got the start of us. And as no verbal description of a work is good for much unless illustrated by drawings, these should always be furnished; but as the making of drawings to a scale and in such style as would be creditable to the contributor as a draftsman would generally consume more time than he could command, it should be sufficient for him to send to the Journal a rough sketch exhibiting all the necessary views of the subject, with the required dimensions and explanations, from which a drawing might be made by the professional draftsman in the employ of the establishment and who should be a person of more than ordinary intelligence and skill.

Failure as well as success in constructed works should be communicated to the Profession through the Journal. The experience derived from failure has often been truthfully said to be more valuable than that drawn from success. The latter makes us often too bold; the former keeps us in salutary check and indicates what we are to shun. The making of these experimental defects known to the world will indeed prove the most difficult of our tasks, and will call for much ingenuous candor on the part of those whose misfortune it has been to do that which has undone itself. And, if that high degree of frankness cannot be practised by the authors of the abortive plans, others, who are witnesses of their want of success must not hesitate to report it for the common benefit, however invidious the office. This should be done of course in the most delicate way and the imputation of personal blame be avoided if possible.

Such are some of the general principles which should govern us in the conduct and support of the periodical which should be established as the organ of our profession and the repository of its theory and practice as developed by the united science and experience of the Civil Engineers of the United States.

Now in the execution of this proposed plan of systematizing our epistolary intercourse with each other on professional subjects, how should we proceed? A few suggestions will essay an answer to this question.

First—we might set up an entirely new Journal, or *second*, we may select for our purpose one of those already in existence.

Difficulties attend both plans; but the most serious I think surround the former, as it would require another convention of Engineers, the assembling of which would be next to impracticable. Better then undertake the office, invidious though it be, of choosing between the papers now established, and proceed to reorganize and enlarge the one which may be chosen, to suit the object we have in view. The two principal periodicals devoted to the subjects of our profession are the "Journal of the Franklin Institute," and the one from whose pages I am now speaking. Upon either stock might be engrafted the improved scion whose cultivation we propose. In regard to the Railroad Journal it is but fair to say that its original establishment was a generous enterprize, which has been poorly rewarded in the hard struggle for existence which it has maintained for the past twelve years. This publication possesses interest in the fact that its birth and that of the railroad system were simultaneous and their existence thus far coeval. I say nothing of the past conduct of this Journal, except that in the feeble support, professional and pecuniary which it has for the most part received, an excuse might be found for a much less spirited and able management than has marked its course.

Of the Journal of the Franklin Institute I need say no more than that it is a paper whose high reputation, enjoyed ever since its institution fifteen years since, is most fully merited. This periodical has possessed a great advantage over those conducted by individual enterprize, in being the organ of a scientific institution whose members have individually and collectively contributed to its support, and whose funds have supplied the occasional deficiencies of its subscription list. By these means it has been enabled to sustain itself and its publication has been uninterrupted and regular. Without being backed by the resources of the society with which it is connected, I am informed, however, that it must have failed for want of pecuniary support, which conclusively shows, that no paper of this kind, dependant upon the punctual payment of subscription dues, can be kept up for any length of time, unless it be propped by such a patronage as I trust can be brought to the Journal which is now suggested as the medium of our professional correspondence.

Between these two publications, it seems to me, our choice must lie. They are published in the two chief cities of the union, with almost equal advantages of position in all respects. I shall, as an individual be satisfied with the selection, let it fall upon either of the two; but upon *one* it must, I think, be definitely settled; for they cannot serve together in the office proposed. The necessity of unity in the organization suggested, is manifest. Interrogatory and reply must pass through the same channel. The article and the criticism of it must appear on the same pages. Of this an illustration was furnished in a number of the Railroad Journal published some months since, in which an author complains that his composition, having first appeared in the Franklin Journal, was commented upon in the other, leaving the separate readers of each acquainted only with the *pro* or the *con*, (as the

case might be) of the question discussed, instead of having both *pro* and *con* before them in one view. Besides, it is essential to the unity and harmony which, it is believed, would be imparted to the actions and relations of the profession, that but one centre should exist from which the beams of intelligence should be radiated or reflected to every point of the professional circle of knowledge. To borrow a geometrical metaphor, the ellipse, with its two foci, would not, it is thought, be the right figure for the purpose. At the same time I must not be understood as presuming to insinuate that the one not chosen for this purpose is to become extinct or to be less active and useful in the course of scince than it may be at present.

The practical difficulty of a selection between these two periodicals or any others that may be named, may however, and in truth does, appear rather appalling. Upon the scheme presented no such concert of action as would attend the proceedings of a convention can be expected. Every individual Engineer whom these suggestions may reach and who thinks them worth acting upon, must express his opinion and cast his vote in the dark. This will be the condition of the question at first; but should there be as it is earnestly hoped there may be, *a general expression of the sentiments of the members thereupon*, light may soon arise out of the darkness, and the conflicting currents of the opinions at first expressed may ere long take a decided set in a direction which shall indicate what is the mind of a majority of the Profession in the matter. From chaos order may come forth. I apprehend more danger from apathy than from anarchy in the republic.

Let us then suppose the effervescence of opposition to have subsided and the "Organ" to be agreed upon. Now to support it upon the principles above developed we must make up our minds to pay well for it. And this we can afford to do, if we consider what the expense would be of attending even the annual meetings of a society, in the place of which our subscriptions to the Journal would stand. Every Engineer who would, if a society were not, (for other reasons) impracticable, attend its meetings and spend from $50 to $100 per annum in doing so, would cheerfully contribute the one-fifth or two-fifths of those sums to a Journal, *if he believed it would accomplish as far as the case permitted, the object of such a society.* Of the extent of this class of Engineers I have no means of accurately judging, but will suppose it might number 100—whose aggregate subscription at $20 per annum would amount to $2000. And further, may not the Profession for the purpose of estimating the revenue of such a Journal, be divided into classes? and, if this be allowable, we may then suppose a second class (I speak in no spirit of invidious comparison) which would pay $10 per annum each, and which might number 200, and, if so, would bring in a further sum of $2000. A third class, consisting of men of general science and information, not having a sufficient interest in the work to go to the same lengths in its support as professional Engineers, might pay $5, and as this class would be a pretty large one we might set it down at 500, in which case it would yield $2,500 per annum. A fourth and final class

might be presumed to consist of contractors, operative mechanics and others who might not, on the whole, be willing to give more than $3 per year; and if they amounted in number to 1000 more, would contribute $3,000. The sum of the contributions of the four classes would then amount to $9,500 per annum. The number of subscribers, supposed as above to be 1,700, divided into this assumed revenue, would give $5·59 as the average subscription for each person. Now although I have assumed the preceding numbers almost at random, they have brought out a result but a little within the subscription price ($6 per annum) of just such a periodical as I have in view, viz: the British "Civil Engineer and Architects' Journal." If that price be sufficient for such a work in England, it would be so, *a fortiore*, in the United States, where books and printing of every kind are much cheaper.

Now it may appear to my readers that this graduation scheme is, at best, a doubtful one, and that no Engineer, however warm his professional zeal and full his professional pocket, would be content to pay $20 or $10, or even $5 for what another class of subscribers got for $3; and this may be so, though I do not think it ought to be so, if the great object in view is exclusively regarded, and fully appreciated, that of maintaining the only or the best substitute for the admitted desideratum of a society of Engineers, at an expense, not one-fourth as great as the latter, even to the most liberal contributor to the "Organ," holding its place. The only way I see to get over this stumbling stone would be to furnish each subscriber with a number of copies proportional to the amount of his subscription; and to do this there must be issued as many as the lowest assumed subscription of $3 would produce by dividing it into the supposed aggregate receipts of $9,500. This would give a quotient of 3166 as the necessary number of copies, or in round numbers 3200, of which each $20 subscriber would get 8 (throwing off the fraction of $\frac{2}{3}$)—each $10 would receive 4 (throwing off the fraction of $\frac{1}{3}$) and each $5, be furnished with 2 (adding the fraction of $\frac{1}{3}$) and the remainder with a single copy each. Then the question is, could 3200 copies of such a Journal be issued for the sum of $9,500?

To enable me to answer this question I have obtained the assistance of a person of experience who has prepared for me a detailed estimate of the annual cost of publishing a periodical (such as I had in view) of 32 pages per month of the form and size of the "Civil Engineer and Architects' Journal," and to be executed in equally good style and as fully illustrated with engravings. The estimate is as follows, for the monthly publication of 1500 copies.

Mechanical department, viz.	
Composition, press work, paper, covering, stereotyping and contingencies,	$2038·08
Publishing department, viz.	
Advertising, commissions, envelopes, postage, porterage, publisher, clerk. etc.,	2200·00
Editorial department, viz.	
Editor, periodicals, lithography, cuts and engravings,	2350·00
Making the total estimated cost of 1500 copies	$6588·08

This includes $568·32 for stereotyping, and the expense of 1000 copies more from the plates is set down at	1679·02
So that the cost of 2500 copies would amount, probably, to	$8267·10
The cost of stereotyping being here estimated at $1·68—to make up the required number of copies we add 700—which at that rate would amount to	1176·00
And the probable cost of 3200 copies would be then	$9443·10
which is a little within the supposed amount of subscriptions.	

But what, it will be said is the $20, the $10, and the $5, subscribers to do with his surplus copies which are but so much waste paper to him? Not so. He may find it easier to get rid of them than might be supposed, and that without committing them to the flames or sending them to the trunk maker. The state of things I have assumed is intended to exhibit only the outset of the scheme. Each subscriber who receives more than one copy becomes at once an agent for procuring more subscribers to participate with him in his burthen. Thus the number of subscribers may ultimately come to equal that of copies published. What cannot be disposed of in this way can be readily parted with to friends at home and abroad, with the pleasure which every professional man takes in such courtesies, and for which also he is usually rewarded by an exchange of something of more substantial value to him than even the satisfaction of the gratuity. Besides the value of the "back numbers" of such a work as would be the offspring of the system proposed, would annually increase as the number of subscribers augmented; and sooner or later all the originally extra copies would be absorbed by purchases to make up complete sets of the publication.

I now respectfully commend the subject to the attentive and *early* consideration of the Profession, in the earnest hope that it may be taken up and discussed with an animation indicative of a general and cordial interest in what so vitally concerns our wellbeing as a body. I owe it to one of the most frequent and valuable contributors to our professional literature (John C. Trautwine, Esq.,) to acknowledge his suggestion of the idea upon which I have enlarged, contained in a note to a communication of his which appeared a year or two since in the Journal of the Franklin Institute—and I trust to find in him a zealous promoter of the plan. At the same time it is due to myself to say that the design of an epistolary association acting through a medium such as I have described, occurred to me soon after it became apparent that a society of the ordinary organization could not be formed; and that the first paragraphs of this article were penned at that time and afterwards neglected, under the press of other engagements. In the canvass of the subject which I trust this appeal will produce and in the criticism to which it may be exposed I deprecate nothing but the indifference which would permit the scheme to sleep without a persevering effort on the part of the Engineers of the United States to realize the benefits it may be capable of conferring.

Benj. H. Latrobe,
Civil Engineer.

Baltimore, Oct. 10, 1843.

For the American Railroad Journal and Mechanics' Magazine.

COST OF TRANSPORTATION ON RAILROADS. BY CHARLES ELLET, JR. CIV. ENG.

(Continued from page 26 Vol. I, Third Series.)

The importance of ascertaining the expense of transportation on railroads, to a large portion of the population of this country, has led to many discussions, and many inquiries, with a view to its determination. No general method has, however, yet been produced, by which it can be ascertained with any tolerable degree of accuracy. The difficulty appears to have arisen, in a great measure, from the fact, that these expenses consist in a variety of elements, which increase and diminish in value by different laws, and at rates which depend on the combinations of these elements in each particular case. It has, also, to some extent, grown out of the fact, that during the progress of this system, every year has produced some new work of improvement, which has supplied new data to calculators—and, unfortunately, data which have preceded the effect of the two greatest causes of expenditure—the destruction consequent on use, and natural decay. Without referring to another difficulty—the extravagant estimates of the friends of particular projects, and, sometimes, the gross misrepresentations of the enemies of others—we see that the subject is much too complicated to be unravelled without close study, and mature reflection. To make a general solution, we have, obviously, to allow for differences of grade, differences of tonnage, differences between the amounts of travel, and have due regard to the length, and even the age of the improvement.

Now, to attempt to go through this whole subject, and produce and analyze the data on which are founded all my conclusions, would require much more labor than I have a disposition, at this time, to appropriate to the question. What I now propose to do, is again to point out the LAW which governs railroad expenditures, and to fix, with greater accuracy, the values of the constant coefficients than was practicable when I first offered the formula which are here repeated.

It is my intention to submit, in the first place, the law which governs the expenditures on a *new road*, and attempt to offer a reasonable explanation, and a just estimate, of the difference between the expenses incident to a new road, and an old one. If my method be true, the reasons, and the values which I assign for this difference, must be obviously just. The general law must first satisfy the mind, and the law of increase, in passing from a new to an old road, must likewise be rational and convincing. If, after this preparatory evidence, I bring forward a certain new road of great length, and show that the calculated cost corresponds well with the actual result, it will certainly be a strong confirmation of the general correctness of the method. But still, for a prudent man proposing to risk his fortune, this alone ought not to be sufficient. This particular example might be selected because it was accidentally found to suit the object; he would have a right, therefore, to call on me to produce a *short* road, and show that the results still correspond with my calculation. His intellect might not yet be fully satisfied; it would be fair for him to call for another example, in which the trade and travel

were both unusually great, in order to be assured that the method is applicable to works of that character also; and, even after finding this result to be confirmatory of the method, extreme prudence would dictate an additional application to another road with very small trade.

All this appearing satisfactory, he could not well retain a doubt; but, when men stake their fortunes, and the comfort and indulgence of their families on the issue, they have a right—they are bound—to exercise great circumspection. Such a party might, therefore, well call for an application of the method to an *old road*—or to one that has arrived at maturity, at least—in order to see whether his investment is likely to be permanently good.

If this doubt be also satisfied; if he finds that the application may be safely made to a road of this description; if, in addition, it is made to one of this sort with a great trade—next, to one with a small trade—then to one with great travel and no tonnage; afterward to a long one, and, finally, to a short one; to some roads with light, and to others with heavy grades—and, if he find that it gives consistent results in all these varied applications—as a reasonable, and as an intelligent man, he will be compelled to admit, that the method is in accordance with THE LAW, and that its results are the TRUTH.

It is such testimony that I propose to offer the reader, and I solicit his attention in order that he may judge fairly of my consistency—for consistency a test of truth. The following propositions are what I designate as Laws:—

I. The cost of motive power, with engines of the same class, is proportional to the distance which the engines run. The cost per mile is *nearly* the same on roads of all grades*—the difference in expense on roads with different grades, consists not essentially in variations of the cost *per mile run*, but in variations of the number of miles which must be performed to do the same duty.

II. The repairs of the road, with equal trade, are proportional to its length; that is to say *cæteris paribus*, it costs twice as much to keep up a road 200 miles long, as it does to maintain one in the same condition, of which the length is 100 miles; just as it costs twice as much to run engines 200,000 miles, as it would to run the same class of engines, 100,000 miles.

III. The repairs of cars are proportional to the number of tons conveyed, and to the distance to which they are conveyed. It costs twice as much to repair cars which run two millions, as it does those which run one million of miles per annum. Again, it costs twice as much to repair cars which convey 20,000 tons a given distance, as it does those which convey 10,000 tons the same distance. The same principle applies equally to the conveyance of passengers; it applies also to accidents, incidentals, and contingencies—for these things increase with and are proportional to, the increase of business.

* The cost per mile run, with engines of the same class is nearly the same on roads of all grades, but if the engines can obtain full trains, or as much as they can carry, the cost per mile run will be somewhat the greatest on those roads which have the most favorable grades. The cost per mile run will be greater on the Reading road than on any other road in the United States on which fuel is obtained at the same rate. The aggregate cost per mile run—i. e. the aggregate expenses for the year divided by the number of miles travelled, if the work is economically managed, will be likewise greater on this road than on any other, of the same age, in this country.

These may appear like self-evident truths, and they are, in fact, so glaring that they scarcely appear to have been looked on at all. The custom now is to regard the expense of cars as proportional to the distance the *engine* runs. It is here made proportional to the distance the *cars* run. It is customary also to consider the repairs of the road as proportional to the distance travelled by the engine—whereas it is only proportional to the length of the road.

These are simple principles, and such as cannot well be doubted, or denied. It remains to state the values of the constants.

REPAIRS OF ROADS.

The repairs of a railroad, I have stated, must be divided into two classes —those which are dependent on, and those which are independent of, the amount of the tonnage. Of the first division, the wear of iron depends entirely on the use, and the wear of the wood, but partially on the use. The rotting of timber, the cleaning out of ditches, the repairs of culverts, embankments, etc., are independent of the trade. But these items are not independent of *time;* the expenses of repairs increase but little until the wood in the sills, ties and rails, begins to decay, and require removal, when they usually soon attain their maximum, and afterward diminish, until they reach a second minimum.

The following table exhibits the cost of repairs on six of the most successful roads in this country, which I have purposely selected from different sections. The table embraces three roads of each of the two great classes—three wooden superstructures with plate rails, and three iron roads with T or H patterns.

By casting the eye down the columns, the progressive increase of expenses will be easily recognized. It must be borne in mind, however, that these numbers do not include the renewal of the iron—an item always charged to "extraordinary repairs," or "permanent improvements,"—as though iron rails were ever permanent, or their destruction extraordinary. Eventually, the cost of the new iron passes into capital stock, or funded debt.

Table showing the Increase of the Cost of Repairs of Railroads.

Year.	Permanent road—edge rail.			Wooden roads—Flat bar.		
	Boston and Lowell.	Boston and Providence.	Boston and Worcester.	Utica and Schenectady.	Petersburg road.	South Carolina road.
1836	---	---	---	---	$251	$870*
1837	$546	$285	$206	$354	664	880
1838	611	411	281	330	542	1040
1839	731	209	405	450	539	982
1840	816	334	830	618	794	592
1841	1200	597	784	837	857	547
1842	1350	514	903	935		503
1843						375

I may add the following notes of the cost of motive power per mile travelled by the engines, which are extracted from documents that were not in my possession when I first stated the cost per mile for passenger engines at 25 cents, and of freight engines at 30 cents:—

* Finished in 1833, when the expenses were very low.

Table showing the Cost of Locomotive Power for 1842.

Name of road.	Miles run.	Expense. Dollars.	Cost pr mle	Year.	Remarks.
Boston and Providence,	35,031	11,399	$32\frac{1}{2}$	1842	Freight engines.
Boston and Providence,	77,774	23,352	30	1842	Passenger engines.
Western road,	397,295	84,165	$21\frac{1}{7}$	1842	Exclusive of wages.
Western road,	397,295	115,000	30	1842	Wages included.
Utica and Schenectady,	155,828	33,454	$21\frac{1}{2}$	1841	Exclusive of new eng.
Utica and Schenectady,	155,828	52,268	$33\frac{3}{10}$	1841	Including new eng's.
Reading road,	83,717	17,443	$20\frac{8}{10}$	1841	With new engines.
Reading road,	198,055	49,800	$25\frac{1}{4}$	1842	New, but heavier eng's

This table entirely confirms the previous estimate [vol. iv, p. 307.] Another table in my possession [derived from reports of 1842] gives for the average value of repairs of locomotives, 7 cents per mile run; my impression is, however, that this item is worth not less than 8 cents, and that future observation will maintain it, for engines that are not fresh from the factory, at about that average.

We may now pass to the method and the rule which I propose for computing the aggregate annual expenses of a road. In the first number of this investigation, I proposed a formula which was published in this Journal, for determining the value of these expenses—stating, however, that there was no line in the country which had yet exhibited results as favorable as expressed by that formula. The present paper is intended to show these expenses *as they are;* the same formula is used, though the constants are modified to suit the actual condition of the system.

FOR NEW ROADS.

The aggregate annual charges on *new roads** are made up of the following items, viz.:—

For every mile travelled by the engines, 24 cents; for every ton conveyed one mile, 9 mills; for every passenger conveyed one mile, 7 mills; and for every mile in length of the road, 300 dollars, facts which are expressed by the formula,

$$\frac{24}{100}N+\frac{9}{1000}T+\frac{7}{1000}P+300h.$$

where N is put for the number of miles run by the locomotive engines, T the tons nett conveyed one mile and P the passengers carried one mile and h the length of the road in miles.

Now, new engines consume as much, or nearly as much, fuel and oil as those which have been used; and they require the same number of enginemen and firemen. The only reduction in the cost of their maintenance, consists in the item of repairs. The bill for repairs for the first year or two, is only about one-half its mean value; and as the average cost of repairs is about 7 cents per mile run, the aggregate cost per mile run on a road which has passed its fourth year, should be $27\frac{1}{2}$ cents, instead of 24 cents.

The *timber* in the superstructure is worth on the average, from 1000 to 1500 dollars per mile, and lasts from 5 to 7 years. The decay of timber in roads of mature age and provided with a single track, is, therefore, about \$200 per mile—so that ordinary repairs on such roads will be about \$500 per mile.

The wear of cars after the road has been a few years in operation, is equivalent to about $4\frac{1}{2}$ mills per ton per mile; and on a new road it is scarce-

* I designate as new, roads less than five years old.

ly appreciable. The difference between the perceptible injury to the road and cars, on a new and old road, is about five mills per ton per mile. The rule then is—

FOR OLD ROADS.

For every mile travelled by the engines, (passenger engines 25 and freight engines 30 cents,) an average of 27½ cents; for every ton conveyed one mile, 14 mills; for every passenger conveyed one mile, 7 mills; and for every mile of road, $500.

If the principles and the values here offered be correct, they will stand the test of trial, and in order to make the test the strongest possible, I will add in a subsequent paper an estimate of the probable results on a road in active operation, and the subject of much speculation at the present time, the correctness of which estimate can be verified at the end of the year.

This rule, if applied to the business of a line in activity, will give only those expenses which are usually denominated "ordinary expenses." In order to arrive at the *true cost* of maintenance we have to add, of course, the extraordinary expenses, which we can likewise estimate with some, though not very great, accuracy, by data now supplied by the improvements of the country.

APPLICATION OF THE FORMULA TO ACTIVE WORKS.

I shall apply this method of computation, in the first place, to a railroad in Georgia, 147½ miles long, with easy grades and little business; next, to one in Massachusetts, 156 miles long, with grades of more than 80 feet to the mile, on which the engines travel nearly four hundred thousand miles per annum, and where the trade and travel are both great; I will then apply it to a short road in the State of New York, which carries no tonnage at all, but which derives its revenue entirely from passengers, and which has moderate grades, and a moderate business; next, I will make the application to a road in Maryland 70 miles long, with grades of 84 feet, and which derives two-thirds of its revenue from tonnage. Finally, I will apply it to a road in Pennsylvania 56 miles long, with favorable grades and moderate business—and again to the same road the next year, when extended 38 miles further, and having an increase of business.

The following table gives the length, grades and business of these roads; and, in the two last columns, are placed, side by side, the actual and calculated expenses.

Table exhibiting the actual and computed cost of maintaining new roads, calculated from the formula,

$$\frac{24}{1000}N+\frac{9}{1000}T+\frac{7}{1000}P+300h.$$

Name of road.	L'ngth miles.	Grade in feet.	Miles trav. by engines	Through tonnage.	Through travel.	Expenses. dollars.	Calculated exps. dolls	Year.
Georgia road,	147½	37	152,873	10,000	12,000	109,819	106,605	1842
Western road,	156	83	397,295	40,000	53,000	256,619	256,187	1842
Syra'se & Utica,	53		84,000		87,881	62,325	68,662	1842
Balt. and Susq.	70	84	128,349	23,000	16,500	75,224	74,379	1842
Reading road,	56	19	83,717	24,000	31,653	62,635	61,318	1841
Reading road,	94		198,055	65,000	33,720	138,900	152,911	1842

The roads named in this table are all those which have been completed less than four years, of which I have been able to procure the trade and travel, aggregate expenses, and distance run by the locomotive engines for the year 1842. In some of these I have been compelled to deduce the through tonnage from the receipts and prices—the reports giving only the aggregate tonnage;—in general the through travel is given with precision.

The agreement between the actual and calculated results in this table, is most remarkable, and exhibits a degree of uniformity in the administration of the lines, which could not have been anticipated. Indeed it is most probably because the roads are so new that the agreement is so perfect. When they begin to feel the effects of time and use, they will give way unequally, and exhibit much wider deviations from the rule. This fact is exemplified in the following table, which exhibits the results of experience on 11 important railroads, selected from different sections of the country. The roads in this table vary in length from 14 miles to 136 miles; in grades from 10 feet per mile, to 83 feet per mile; in freight from nothing to 94,000 tons; in travel from 7,000 to 180,000 passengers; and in expenses from 30,000 to 225,000 dollars per annum.

Table exhibiting the actual and computed cost of maintaining roads which have been completed more than four years, calculated by the formula,

$$\frac{27\cdot5}{100}\mathrm{N}+\frac{14}{1000}\mathrm{T}+\frac{7}{1000}\mathrm{P}+500h.$$

Name of road.	Year.	L'ngth miles.	G'de. in ft.	Miles run.	Through tonnage.	Through travel.	Actual ex-pen's, dols.	Calculated exps. dolls.
Bost. and Prov.	1842	42	38	120,000	21,200	117,129	101,596	100,897
Balt. & Wash.	'41-2	30½		91,428	27,369	114,260	73,684	76,166
Petersb'g road,	1842	61	30	131,160	22,000	16,000	96,398	92,489
Nash. & Low'l,	1841	14	10	44,040	28,663	85,737	30,708	33,131
Balt. and Ohio,	1842	82	82½	299,617	44,477	34,380	220,135	192,925
Ports. & Roan.	1842	79		96,000	5,975	7,662	73,345	76,703
Bost. & Lowell,	1842	26	10	143,607	93,927	179,819	131,012	119,409
Phil. & Colum.	1842	82	45	261,844			116,000	112,979
S. Carol'a. road,	1842	136	35	260,324	27,000	24,000	225,743	213,945
Bost. & Worc'r.	1842	44½	42	241,319	61,911	165,720	168,509	176,815
Utica & Schen.	'41-2	78		152,764		114,527	154,436	143,542

[NOTE.—The miles run on the *Petersburg road* are assumed to be the same as in 1841; the tonnage is estimated from the tonnage of 1841, with an allowance for the increased receipts. The results on the *Baltimore and Ohio road* for 1841 are preferred, because those of 1842 are complicated by the extension of the line to Cumberland. The report of the *Philadelphia and Columbia road* contains only the expenses of motive power and repairs; the freight and passengers are conveyed by other parties; we have, therefore, in the formula to make $\mathrm{P}=0$ and $\mathrm{T}=0$, for this case. The tonnage and travel on the *South Carolina road* are deduced from the printed reports. The actual expenses on some of the lines will be seen to differ from other published statements; this will be found to arise from the fact that these statements contain charges for interest, ferries, cars and motive power on branch roads, which, of course, are rejected in this comparison.]

Here is presented a list of eleven roads, situated in different sections of the

country, and offering every variety of length, grade and business that could be desired, in order to put the formula to the severest test. The greatest difference which is exhibited in the whole list between the actual annual cost of maintenance, and the estimated cost, *is* 12 *per cent.;* certainly no closer agreement could be expected, since the actual expenditures fluctuate to that extent—and perhaps, through wider limits—from year to year; the removals of decayed timber, and various contingencies, being found much more extensive some years than others. In looking over the list I am able to account, in almost every instance, for these departures from the formula, by my personal knowledge of the situation of the line. It will probably be seen on some future occasion, that those roads which now exhibit expenses above the formula, will fall below it for other years—a remark which is applicable to the Boston and Lowell, Baltimore and Ohio, and South Carolina roads. I hope they may never again rise above it.

It is no part of my object to flatter the expectations of railroad companies, but to exhibit to them and the public the truth. To those companies whose works are now new, and who *seem* to be making money, I would suggest the timely formation of a contingent fund, to prepare them for a contingency which will as surely reach them as the next new year. It is bad policy to divide the *annual expenses* as if they were real profits; the money that is earned at the expense of the rails, cars and machinery, should be hoarded to replace those things, and not distributed, as if they were to last forever. It can be shown that every company should annually store away, in times of prosperity, while their work is new, at least 6 cents for every mile travelled by their engines, 1 cent for every ton conveyed one mile, and 200 dollars for every mile of road, to replace decayed materials, and injured iron and machinery. If their profits will not permit that reservation, then the prudent man will avoid their stock; and the company should cut down their expenses to the limit assigned by the trade. Where these expenses do not consist of interest on debt, this retrenchment is almost always possible.

In the first of these tables the Reading railroad appears to escape the application of the rule; the calculated expenses exceeding the actual charges, as stated by the company, some $14,000, or about 10 per cent. There has probably been a division made between the current and contingent expenses on this line; indeed, on inspecting the published exhibit, I find that the whole sum set down for *timber* used in repairing 94 miles of road, including rails, sills, etc., is just $2,431. Now, I know personally, that twice that sum would not pay for the timber required for repairing the bridges alone. The bridge account last year must have amounted to more than $12,000, and seems not to be included in the published statement. This sum being added to the published total, brings the year's expenses up to $151,000, or within 1¼ per cent. of the formula. Perhaps the company regard the loss of a bridge as so extraordinary an occurrence, that it can never take place again; but their report already points to another which is found to be "less permanent than the rest;" and time will show that no part of railway

superstructures will long remain permanent under the action of heavy engines and their trains. Besides, there will be freshets, and tornadoes, and fires; and on a road which has a great many bridges constructed of perishable materials, and which is travelled by 25 or 30 locomotives every day, or about 10,000 trains a year—with engines using pine wood for fuel—many such accidents must be expected. One bridge per annum is a small allowance for the average loss; and if the bridges happen to be fortunate, there will be rotten sills or crushed iron enough to compensate for the difference.

We perceive then that the formula applies also to this road; and I will now insert a table exhibiting its application to all the roads of which I have been able to obtain the amount of trade, and annex a column showing the per centage of error for each; not having the number of miles run by passenger and freight engines separately in every instance, I make use of the mean value 27½ cents per mile run.

TABLE.

Name of road.	Year.	L'ngth	G'ds.	Miles run.	Through tonnage.	Through travel.	Actual expenses.	Calculated expenses.	Error per ct.
							Dollars.	*Dollars.*	
Georgia road,	1842	147½	37	152,873	10,000	12,000	109,819	106,605	—2¾
Western road,	1842	156	83	397,295	40,000	53,000	256,619	256,187	0
Syrac. & Utica,	1842	53		84,000		87,881	62,325	68,662	+10
Balt. & Susq.	1842	70	84	128,349	23,000	16,500	75,224	74,379	—1
Reading road,	1841	56	19	83,717	24,000	31,453	62,635	61,318	—2
Reading road,	1842	94	35	198,055	65,000	33,720	151,000	152,911	+1¼
Bost. & Prov.	1842	42	38	120,000	21,200	117,129	101,596	100,902	—⅗
Balt. & Wash.	'41-2	30½		91,428	27,369	114,260	73,684	76,193	+3½
Petersburg road,	1842	61	30	131,160	22,000	16,000	96,398	92,310	—4
Nash. & Low'll,	1842	14	10	44,040	28,663	85,737	30,708	33,131	+8
Balt. & Ohio,	1841	82	82½	299,617	44,477	34,380	220,135	192,925	—12
Ports. & Roan.	1842	79		96,000	5,975	7,662	73,345	76,703	+5
Bost. & Low'll,	1842	26	10	143,607	93,927	179,819	131,012	119,409	—9
S. Car'lina road,	1842	136	35	260,324	27,000	24,000	225,743	213,945	—5
Bost. & Worc'r.	1842	44½	42	241,319	61,911	165,720	168,509	176,831	+6
Utica & Schen.	'41-2	78		152,746		114,527	154,436	142,542	—8
Phil. & Colum.	1842	82	45	261,744			116,000	112,979	—2¼
					T'ns 1 mile	Pas. 1 mile			
Aggregate,		1251		2,886,292	33,360,560	58,633,722	2,109,188	2,074,512	

NOTE.—[By "through tonnage" and "through travel," is to be understood the whole number of tons and passengers carried one mile, divided each by the length of the road in miles. It is much to be regretted that companies do not give these facts in their annual reports.]

One word more in reference to this table. I offer here a list of 17 railroads, presenting almost every conceivable variety of length, grade and character. It is not a *selected* table, but contains the results of one year's operations on *every* road, without exception, concerning which I have been able to obtain the necessary data—materials which have only been procured by dint of great exertion. It will be seen that the management upon these various lines is very nearly uniform, and that they are *all* obedient to the *law.* The greatest departure from the formula is 12 per cent.

Now, this list embraces roads which are situated in every one of the seaboard States from Maine to Georgia; the aggregate length of line exhibited is 1251 miles; the engines traverse annually a space of 2,886,300 miles, and they carry no less than 33,360,560 tons, and 58,633,722 passengers 1 mile. The aggregate ordinary expense of maintaining this length of line, and accommodating this amount of tonnage, is actually $2,109,188 annually, and the calculated expense $2,074,512. The difference between the calculation and the fact is $34,676, or less than two per cent.

I conceive, therefore, that I have authority sufficient for announcing this formula as expressing the general law of railroad expenses—a law to which all the roads in the country are obedient. If stronger evidence of its correctness could be offered, I know not in what it would consist.

It is in vain to urge here that a certain road has peculiarly steep, or peculiarly light, grades, which should exempt it from the application of the rule. The formula which I announce, accounts for these differences. When the grades are easy, the engines make fewer miles, and the rule looks only to the miles.

There is yet another point of great importance connected with this subject, which ought not to be overlooked, viz., the "extraordinary expenses." It is the custom among too many of the parties interested in the railroads of this country, to look upon the suggestion that iron may be worn out, as a thing so chimerical and visionary, as to be entirely unworthy of their sober thoughts. In the course of a few years they are surprised by the fact—the certainty—that money must be raised, for that their iron must be renewed. Instead of being warned by experience, and commencing immediately the work of retrenchment, and the provision of a surplus fund to meet the recurrence of the contingency, they look upon it as extraordinary in the extreme—a sheer accident, which cannot occur again, or which can be warded off by a heavier iron. Experience and common sense teach that heavier iron will be attended with heavier expense; but they have *not yet* taught that the wear will be less. A heavier rail may longer resist a given trade; but will each dollar put into the heavy rail go farther? This however, is a subject which must be reserved for a future number of the Journal.

(To be continued.)

The following communication from Mr. Whittle is worthy of consideration. Whatever changes in the details of his plan circumstances may dictate, the general principle is a good one and should be in more frequent operation than at present. The suggestions of Mr. W. are not *trifling* and we should be most happy to receive many more such *trifles* from him and from others of the profession.

For the American Railroad Journal and Mechanics' Magazine.

In my last annual report to the Monroe railroad company, of Georgia, I proposed the following remarks, which if carried into use, I feel confident would add much to the present prosperity of railroads and advance the interest of their owners.

1st. To encourage planters, who forward their freight, also to travel on the road, give them $\frac{25}{100}$ of the amount of their *freight paid*, in tickets, which tickets will be received for the fare of themselves and families during the year in which they are issued, one-half being paid each time *in cash*. Thus, A sends freight over the road, amounting to $100, which he pays in cash; the railroad company then furnish him with tickets to the amount of $25, which will be received from him or his family for *fare* when they travel, one-half the fare each time being paid *in cash*. The tickets should not be transferable and if not used the year in which issued, should be void.

2d. Many of our roads, in the south at least, have been under weigh for years, without paying the shareholders any interest; during which time, they have had to pay customary charges when they have used it in any way. I would propose that tickets be furnished them each year, till their investment pays an interest to the amount of one-fourth of the interest on their stock, which would be received as above, and that they might also apply to freight on goods as well as fare for passage, which alone was intended for the planter.

I speak from experience and feel very confident that these two suggestions, trifling as they may seem, if carried out, will add greatly to the use of public works and receipts of the companies, especially when the stock is owned by persons living along the line of road. The proportions to be given in tickets, of course, would be varied to suit each case.

September, 1843. L. N. W.

For the American Railroad Journal and Mechanics' Magazine.

Messrs. Schaeffer & Minor,

The article under the head of "Revolving Steamer," in the September number of the Railroad Journal, describes, I think, not exactly but very nearly a machine which was invented some years since by J. N. Pomeroy, Esq. of Burlington, Vt., a description of which he communicated to, and was published in the Railroad Journal. I do not recollect the year, but it was near the commencement of the Journal. If upon examination you consider me right in my conjecture, I will not insist on your "yielding the editorial pen and scissors," provided you will apprise the New Orleans inven-

tor through your columns that he has probably been anticipated in his discovery. FULTON.

This communication came to hand too late for a reference to the article referred to. A notice will appear in the next, and if our correspondent thinks he has the better of us we *will* yield him our editorial "pen and scissors."

ENGINEERING.

We learn with pleasure that Mr. *Edwin F. Johnson*, and Mr. *William R. Casey*, Engineers well known to the readers of the *Journal*, have established an office in this city where they will devote their attention to the numerous works which *ought* to fall within the range of the Profession, and which indeed constitute its main occupation in Europe.

Strange as it may appear, there is not an office in this city where persons can obtain the advice and assistance of experienced Engineers in the numerous instances where such aid is obviously wanted. These subjects are alluded to in the circular, a copy of which accompanies this number, and again more briefly in their advertisement.

We called attention sometime since to this view of the duties of the Profession and still believe that, by making proper exertions throughout the country, all its *permanent* members would soon find profitable and steady employment. Nothing would conduce more to this desirable end, than the simultaneous establishment of similar offices in all our main cities by men of undoubted skill and character. We shall be happy to give all the assistance in our power to increase the usefulness of the Profession, and hope soon to see the advertising columns of the Journal adorned with similar notices of Engineers in different parts of the country bringing their claims prominently yet fairly before the community.

IRON STEAMER ON LAKE ERIE.

We extract the following from a letter recently written to a friend in this city by a young gentleman in the service of the government, from Erie, Pennsylvania.

"Our iron steamer is fast progressing. I was really surprised at the foresight and ingenuity of Mr. Hartt, the constructor. Nothing came amiss, all the 100,000 holes fitted, and very few indeed were to be drilled. One would think he had built fifty iron vessels instead of this the first. The strains are all counteracted with great judgment, and in reading works on the subject, published since she was drafted, there are some new suggestions which he had before adopted."

It would gratify us if Mr. Hartt or the young gentleman above alluded to would send us, for publication in the columns of the Journal, a detailed description of the plan of construction of the steamer mentioned, and the machinery connected therewith; also a description of the performance of the vessel when put afloat.

Information of this description cannot at the present time be too widely diffused.

ACCIDENTS UPON RAILROADS.

In our number for September, I took occasion to refer, in a manner somewhat pointed, to the frequent occurrence of accidents upon railroads. To those who have been familiar with the course of this Journal in relation to the railroad cause, during the past twelve years, I deem it altogether unnecessary to say more than that those remarks were made with a single eye to the *safety* of those whose business places them within the reach of injury from such casualties, and of course, therefore, to the *interest* of the proprietors of railroads. There was no intention to single out any particular road for censure, but to speak of the most recent accidents as the information before the public seemed to call for, with a view, or in the hope of calling that attention to the subject which its vast importance imperiously demands. Whether they have had the desired effect to arouse the attention of others who have experience in the management of railroads, and the ability to point out the *cause* and suggest a *remedy* for accidents, or not, is now of little importance, inasmuch as the subject has been taken hold of by one who is evidently familiar with it, as will, I think, be seen from the communications signed "T," in our last, present, and succeeding numbers, having now two numbers in hand, which we received too late for this number, from the *Balt. Amer.*, to, and upon which, we ask the special attention and comment of our readers. Let those whose interest is so intimately connected with this matter give it their early attention, and if need be, apply to their respective legislatures for such additional laws as may be necessary to prevent the remaining of cattle upon railways, for the right of way for which, most of the companies have been compelled to pay more than the value of what they occupy. Let the travelling community also, who have what may be termed a *life and limb* interest in the establishment of a thorough system of police for the management of, and prevention of accidents on railroads, urge upon their representatives the *necessity* of such laws as will secure its safety and protect the rights of those who have invested their capital in the construction and management of railroads; an investment, which has thus far at least, contributed far more to the interest of those who are *not* than than those who *are* stockholders. D. K. M.

The letting of the Mad river and lake Erie railroad, from Tiffin to Carey—a distance of 16 miles—took place on the 26th ult. We learn from the Urbana Citizen that the contract for the entire work was given to Mr. Reed, of Tiffin, at $48,000—about $3,000 per mile.

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AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5.

By GEO. C. SCHAEFFER, and D. K. MINOR, Editors.

No. 12, Vol. I. Third Series.

DECEMBER, 1843.

Whole No. 431. Vol. XVI.

For the American Railroad Journal and Mechanics' Magazine.

COST OF TRANSPORTATION ON RAILROADS. BY CHARLES ELLET, JR. CIV. ENG.

(Continued from page 349.)

REPAIRS OF ENGINES AND CARS.

It is the custom of many companies to publish the cost of repairs of their cars and engines in a single item, so as to make it impossible for the reader to determine, from their accounts, what portion of the bill was created by the engines, or the difference between the repairs due to different sorts of cars; but still an industrious investigation of the subject gives us facts enough to estimate these separate items for ordinary cases, with all desirable accuracy. I have stated in a former paper that the repairs of burthen cars are worth, on the average, 4½ mills per ton per mile; and that the repairs of the engines averaged, during the year 1842, *seven* cents per mile run. I have also observed that the repairs of passenger cars vary from three-fourths of a mill to a mill and a half, and sometimes exceed 2 mills per passenger per mile. If these facts—all of which enter into the formula which I have offered for the determination of the aggregate annual expenses of a railroad company—be well established, they will not only stand the test of trial for the aggregate, but they will apply in detail. Not only should the formula for determining the aggregate expenses be correct, and correspond with actual results—as we have seen—but the separate items of which it is composed, must, likewise, bear the test, and give results in agreement with the average results of experience.

It is not pretended that a formula could be offered which would show the exact cost of every item of every company for every year—because the actual expenditures due to each item fluctuate from year to year; but it is maintained that these fluctuations are above and below a certain average line, from which they may depart towards either side for a certain time, but to which, and beyond which, on the opposite side, they are as sure to come as the pendulum is sure to approach the vertical in its vibrations. Although it was not my intention to enter so minutely into these details, probably

more confidence will be yielded to my statements when the data on which they are founded are presented. These data, for the repairs of engines, are exhibited in the following

TABLE.

Name of roads.	Year.	Miles run by engines.	Cost of repairs of engines.	Repairs per mile run.	Remarks.
			Dollars.	*Cents.*	
Phil. Wilm. & Balt.	1842	177,859	17,071	·9·9	Old road.
Western road,	1842	397,295	24,177	6·1	New road.
Georgia road,	1842	152,873	10,155*	6·7	Ordin'y & extr'ny rep's & improv'ts.
Baltimore & Susq.,	1842	128,349	7,193	5·6	New road.
Utica & Schenec.,	1842	150,000	10,346	6·9	Passenger business.
Baltimore & Ohio,	1841	299,617	20,640	7·0	Old roads in good condition.
Baltimore & Wash.	1842	95,817	7,973	7·2	
Philad. & Columb.,	1842	261,744	21,915	8·4	Genr'ly fre't. bus'ns.
Boston & Provid.,	1842	112,805	7,257	6·5	Old roads in good condition.
Baltimore & Ohio,	1843	509,765	35,941	7·0	
Wash. & Baltimore,	1843	96,716	6,714	7.0	
		2,382,840	169,380	Av7·1	

This table exhibits the cost of repairs of engines which have traversed a space of 2,382,840 miles; and shows that the average is within one-tenth of a cent, per mile run, of the mean value at which I had stated it. It is my impression, however, that the average on these same roads will be greater for the year 1843.

Now, if we call N the number of miles travelled by the locomotive engines; T the number of tons of freight carried one mile; and P the number of passengers carried one mile, the average aggregate cost of repairs of passenger and burthen cars, and locomotive engines, will be shown, very nearly, by the formula,

$$\frac{7N}{100}+\frac{4.5T}{1000}+\frac{P}{1000}.$$

By expressing the cost of repairs in this way, we are able to determine, at once, the expenses of repairs for an entire train composed of either description of cars, or of both sorts, combined in any proportions.

Although this, and all my other, estimates might be much strengthened, by bringing forward facts resulting from former experience, I prefer, with one or two exceptions, to limit my examples, on this occasion, to those works of which I have obtained authentic information for the year 1842. Of course, I exclude those lines which have been so recently completed, as to require no repairs at all for cars.

The following table presents the number of miles run by locomotive engines, and the number of tons and passengers carried one mile on eight railroads for the year 1842, and two for 1843—which have been recently

* This company have added to the usual division of their expenses into ordinary and extraordinary repairs, the new classification of "improvements to engines;" not being able to conceive that a small stock of engines could run 153,000 miles, and be materially improved by it, I regard these "improvements" as expenses.

published;—and in the two last columns will be seen the actual expenses of repairs of cars and engines, and the expenses of the same computed by the formula.

TABLE.

Name of road.	Year.	Miles run by engines.	Tons carried one mile.	Passengers carried one mile.	Actual cost of repairs.	Computed cost of repairs.
					Dolls.	*Dolls.*
Petersburg road,	1842	131,160	1,342,000	976,000	16,513	16,196
Boston and Providence,	1842	120,000	890,400	4,919,418	13,506	17,326
Baltimore and Ohio,	1841	299,617	3,647,093	2,495,911	45,534	39,881
Baltimore and Ohio,	1842	334,519	3,985,425	2,738,779	44,568	44,189
Baltimore and Ohio,	1843	509,765	7,109,310	6,062,455	62,862	73,738
Baltimore and Wash.,	1843	96,716	805,429	2,646,719	17,453	14,801
Baltimore and Susque.,	1842	128,349	1,610,000	1,165,000	13,370	17,390
Baltimore and Wash.,	1842	95,817	877,138	3,188,948	17,053	13,864
Utica and Schenectady,	1842	150,000		8,413,704	18,842	18,914
Boston and Lowell,	1842	143,607	2,442,102	4,675,294	28,816	25,716
Georgia road,	1842	152,873	1,475,000	1,770,000	19,899	19,107

On inspecting this list we will observe that the actual charges on some of the roads are a little above, and on others a little below, the indications of the formula—but that the deviations are in no instance too wide to render the rule, as far as it goes, a safe test of the value of an investment. The actual cost on the Baltimore and Ohio railroad falls considerably below the computed cost for the year 1843. In 1842 the agreement was very close, and in 1841 the result was nearly as much above as that of 1843 is below the rule. Indeed, in 1841 the sum of $9,766 was expended for *new* burthen and passenger cars, in addition to the $45,534 charged to repairs of cars and engines. The aggregate expenses for repairs of cars and engines, on that work, for the three years amounted to $152,964—and the expenses calculated by the formula to $157,808. If we add the sum paid for *new cars*, to the actual cost of repairs, the actual expenses, for the three years, will be $162,730, or 3 per cent. above the computed expenses.

The formula simply exhibits what it is intended to show—the average for a succession of years. I do not include the Boston and Worcester road in this table, because the result on that work is entirely anomalous. For previous years the agreement between the calculation and expenses was sufficiently close; but in 1842 there was a material increase of business, an extraordinary reduction in the expense of repairing the cars and engines, and a simultaneous augmentation of the capital—or charge for construction—of $390,000. I am obliged to suppose that new cars and engines were added to the line, and that a portion of the business was performed by new stock.*

We may now pass to another very important division of railroad expenses, which are usually, though very improperly, denominated "extraordinary expenses." I refer chiefly to the

* The cost of repairs of locomotive engines for this road, for the year 1841, was 9 1-2 cents per mile run, and in a space of seven years, from 1835 to 1841 inclusive, the engines performed an aggregate distance of 850,809 miles, at an aggregate cost of $84,183; or within a fraction of 10 cents per mile run. The repairs of cars are fluctuating, but the average is in accordance with the formula. This road is not an exception to the rule, though the formula does not apply for the year 1842.

WEAR OF IRON RAILS.

There is, perhaps, no subject of interest to the engineer which has attracted less serious attention, or has been more vaguely and indefinitely considered, than the wear of railroad iron. Instead of attempting to find some correct and rational measure of this wear, the public, and in a great measure, the profession also, have persisted in regarding the visible destruction of the iron on roads which have been some years in operation, as a consequence of the inferior quality of the particular specimen, or of the inadequate strength of the particular pattern. It is the custom to say that the mashed and splintered iron of the Camden and Amboy, and Columbia roads was bad; but no argument has ever been adduced to show that good iron, in the same situation, and subjected to the same sort of treatment, would do better.

So long as railroads happened to occupy positions where they would be used for the mere conveyance of the travel, and a few thousand tons of goods, between adjacent cities, the durability of iron was a question of subordinate interest. An engineer could be satisfied that his rail would last 10 or 20, or 30 years, and could generally count on a sufficient increase of business consequent on the increase of population, to compensate for its destruction in that space of time. But railroads are now projected to take the place of important canals, and to furnish the means of transport for the heavy products of the earth at exceeding low rates. The question assumes, therefore, another aspect. The trade of the Erie canal in New York, and of the Schuylkill Navigation in Pennsylvania, may be estimated at 800,000 to 1,000,000 tons per annum; and there is no railroad in the United States worked by steam power, which accommodates more than the one-ninth, or one-tenth, of this amount, with the exception of the Reading railroad, which has not yet been long enough in operation to yield any useful practical results.

The common half-inch flat bar, under ordinary circumstances, is adequate to the transportation of about 150,000 tons of freight. Such a bar on the Petersburg road, where the freight amounts to some 25,000 tons, would resist the wear of six years' business; but if one year's trade of the Schuylkill canal were poured along it, the iron part of the track would need entire renewal *six times in one year.*

The same remark is applicable to any of the same sort of wooden roads in the country. They would all bear about 150,000 tons net, drawn at the usual speed of ordinary freight engines, but would be completely destroyed by about *five weeks' business* of the Schuylkill Navigation, in the season of active trade.

It must be admitted that we have not yet sufficient data for estimating, with entire certainty, the probable durability of many varieties of rails. We have, however, data sufficient, if we use it properly, to make a much nearer approximation than is generally supposed to be practicable. The durability of the half inch plate rail can be determined with all desirable

accuracy, and we can judge from analogies, which the problem presents, the probable wear of other patterns. Great errors have been committed in the consideration of this subject, by overlooking the fact that the progress of the wear is rarely ascertained, or, in the least, appreciated, until the rail is destroyed. The *annual* charge for iron is very small, because, in general, the track does not appear to give way until it is nearly unfit for use. When repairs really commence, the destruction is so far advanced that the iron must be renewed; and if the directors assert, as they usually do, in their next report to the stockholders, that experience has shown that the original iron was very bad, and has all been crushed, the explanation is satisfactory, and the cost of the new iron is forthwith charged to the account of construction.

We accordingly find, in looking through the reports of railroad companies, that the average annual increase of capital, generally exceeds the dividends even of the most successful enterprises: and *there is not now to be found in the country a single road which has renewed its iron out of the proceeds of transportation.* While the trade continues to be small, and this extraordinary outlay is needed but once every six or eight years, the self-deception can be practised with considerable success. But there are now works constructed which are intended for a very great business, and and which will reduce the extraordinary charge for renewal of iron down to a very ordinary circumstance. The Reading railroad is contemplated for the conveyance of the present trade of the Schuylkill canal—from eight to nine hundred thousand—and which will very soon reach one million of tons—and should the experiment succeed, *the cost of iron will be more than equal to the entire renewal of a single track every year.* The question of wear, is, therefore, of immense importance, and can no longer be lightly disposed of by companies of this class.

This, as every other item of railroad expenses, is subject to a certain law, which must be recognized before we can make any effectual progress in our investigation.

The destruction of iron depends on the grades of the road, on the tonnage, and on the travel. Every ton of freight that passes produces a certain amount of injury; every passenger car and every passenger does some injury, and every engine that traverses the line produces its share of mischief; but the number of engines that traverse the road, in conveying a given amount of tonnage, depends on the limiting gradient—and, consequently, the destruction of iron, *cæteris paribus*, is greatest on those roads of which the grades are most unfavorable to the useful effect of the power.

If we call N the number of miles travelled by all the engines on the line; T the number of tons net conveyed one mile; and P the passengers conveyed one mile, for one year, then

$$a\,\mathrm{N} + b\,\mathrm{T} + c\,\mathrm{P},$$

will be the form of the expression which represents the amount of injury which the iron has sustained—a, b, and c, being constants to be supplied by

experiment. It is assumed, of course, that the weight and form of the rail, as well as the weight, construction, and velocity of the engines, are uniform.

The point, now, is to determine the values of the coefficients, a, b, and c. For this purpose I take, in the first place, a road on which engines are not used, and but few passengers are conveyed. The wear of iron on such a road gives us the value of b, or the injury done by the tonnage.

There are two works of this description of which we can find published reports, and which have been long enough in activity to destroy a portion, or the whole, of their iron.

The *Chesterfield railroad*, in Virginia, constructed with a flat bar, and using horse power and light cars, has required, for some years past, about $200 per mile for new iron, to replace that which is destroyed by the passage of an average trade of about 50,000 tons of coal. The destruction is here equivalent to *four mills* per ton per mile.

The *Mine Hill and Schuylkill Haven railroad* was originally constructed with a flat bar, and six miles in length of the road had been renewed with a heavy edge rail, before 400,000 tons had passed along it. Assuming the value of the flat bar at $60 per ton, or $1200 per mile, which is below its present value, and that the iron was worn out by 400,000 tons, the result will be three mills per ton per mile. But this road is provided with a double track, and the track which was destroyed was not used by the ascending cars.

The injury produced by the empty cars is certainly more than one-third of that effected by those which are loaded; and the result on this road, therefore, corresponds very closely with the previous example. The wear then obviously will not be less than four mills on a road sustaining locomotive power—where the velocity is much greater than on the Chesterfield and Mine Hill roads.

I will not, therefore, be above the mark in assuming $b = 4$ mills.

The flat bar on the *Petersburg road* may be considered to have been worn out in six years, by use which was equivalent to 12,000 trips of locomotive engines; 130,000 tons of freight, and 100,000 passengers carried over each mile. If we consider the injury caused by cars carrying five passengers, equal to that produced by those carrying one ton of freight, and the value of this iron equal to $1200 per mile, we shall have

$$b\,\mathrm{P} + c\,\mathrm{T} = \$600$$

for the damage due to the freight and passengers.

The remaining sum of $600 is the destruction produced by the 12,000 miles run by the locomotive engines; whence we have

$$a = \frac{60{,}000}{12{,}000} = 5 \text{ cents};$$

or five cents for the injury done by the passage of the locomotive engine over every mile of the road.

We obtain, then, from this procedure, $a=5$ cents; $b=4$ mills; and $c=\frac{4}{5}$ mill, and for our formula

$$\frac{5\text{N}}{100}+\frac{4\text{T}}{1000}+\frac{4\text{P}}{5000}.$$

If these values be correct they will apply to any other similar case.

The first iron used on the South Carolina road, was destroyed in less than six years—after it had borne about 130,000 through tons, and 120,000 through passengers, and the locomotive engines had made 10,000 through trips. The formula will give for this case,

$$\frac{10{,}000\times5}{100}+\frac{130{,}000\times4}{1000}+\frac{120{,}000\times\frac{4}{5}}{1000}=\$1{,}116$$

for the destruction of the iron per mile. This is, no doubt, very near, the true value of the first iron used on that road, estimated at the present prices.

There are several other roads, of both descriptions, for which similar computations might be made, and which would confirm the estimate—and I shall take occasion, at a subsequent period, to present much data of the same character in a tabular form. But without discussing this branch of the subject further, at present, it may be stated in round numbers, that the average destruction of the half inch plate rail, caused by engines, freight, and passengers, is equal to about 8 *mills per ton net per mile;* and by comparing the above expression of the wear of the rail, with that previously obtained for the wear of the cars and engines, we will perceive that they possess very nearly the same value—or that the injury done to this iron, by the passage of a train, is but about 10 per cent. less than the wear and tear of the engine and cars composing the train.

In the application of this formula, however, the fact is not to be overlooked, that it is derived from the destruction of the plate rail, and is intended only to be applied to that description of road. *The destruction of any form of* T *or* H *rail, which I have yet seen, will be greater.* It is true that the expenses of maintenance for some new roads, provided with heavy iron, are yet very light, and they will possibly continue to be light until they have carried from three to five hundred thousand tons of freight —when, if the rail is still in existence, they will be very heavy.

It requires but little experience, and no speculation, to bring us to this conclusion. Let us take the two patterns, fig. 1, and fig. 2, for the purpose of illustration. Fig. 1, is a common form of edge rail, of 60 pounds per yard, of which the head, or upper table, A, weighs 20 pounds. Fig. 2, is a common plate rail, $2\frac{1}{2}$ inches wide, by $\frac{7}{8}$ of an inch thick, which also weighs about 20 pounds.

This flat bar is supported along its whole length and breadth by the

wooden string, S, and the edge rail is supported only in the centre by the vertical stem, P. Is there now any reason why the unsupported flanch, *f*, should do more service than the supported flat bar, B? The vertical stem and base of fig. 1 never wear out; it is the head of that rail which is crushed and rolled to pieces. When the rail is destroyed the lower portions are untouched; but when the head is bruised and split, the whole rail is rendered useless—and when the rail is ruined, 60 pounds of iron per yard, are lost to the company. The flat bar will bear just as much—indeed, being supported, a little more—hammering, and when it is destroyed, but twenty pounds are lost. Besides it may be welded when broken, the ends may be "upset," and restored when split; new holes, when necessary, may be punched, and it can be returned to the road until the lamination and splintering throughout render it wholly unfit for useful service.

But it is not my intention to speculate here on the relative merits of rails. The present object is to adduce facts and conclusions based on observation of many roads of various descriptions, in relation to the destruction of such rails as are ordinarily adopted. I know that my opinions on this head are not those of the public, nor of many professional gentlemen of much experience; but I believe they are, nevertheless, correct, and I therefore submit them to a test which will speedily be applied, and by which this question will be most conclusively settled.

The rails of the Reading road are, by common consent, acknowledged to be good; the pattern is considered, by the advocates of edge rails, to be unexceptionable; and the mode of manufacture adopted—that of making the lamina horizontal—is considered to render them almost proof against wear.

In regard to these rails—with all their merits, and all their superiority—I affirm,

1st. That they will not withstand the rolling of the trade of the Schuylkill for one year.

2nd. That before 800,000 tons of coal have passed down and the empty cars have been returned on them, the present track will be entirely unfit for safe usage.

3rd. That it will cost from 50 to 75 cents to replace the iron which is destroyed by each ton of coal that descends from Pottsville to Richmond, on the present track. And,

4th. That before next August, if the company succeed in obtaining the trade which they desire, this rail will be pronounced *too light* by the very parties who now think it will last forever.

The fault, however, is less in this particular rail than in *iron*, which is not tough enough for such usage, at such prices.

I know that the *Providence road* will be adduced as evidence against me, where the road has been some six years in use, and the iron is yet sound; but the Providence road actually passes but 30,000 tons per annum on a single track, and must yet stand 25 years before it can do one year's business of the Schuylkill canal.

The *Georgia road* may, perhaps, be quoted as evidence, where *experience*, they say, has demonstrated, beyond all question, the ability of railroads to compete with canals for the conveyance of heavy freight; but the Georgia road has been less than three years in operation, and has *not yet carried as much freight as has sometimes passed along the Schuylkill canal in three days!* Pour the trade of the Schuylkill, or Erie canal on parts of that road, with such engines as would be needed for its conveyance, and the track would be crushed in less than four weeks.

The *Boston and Lowell road* will be quoted. This road has not yet carried, in the eight years of its existence, an aggregate tonnage equal to the annual Schuylkill trade—and that tonnage has been sufficient for the destruction of the first track of edge rail, and the company are now, and have been for some time, using the second and third tracks.*

The *Camden and Amboy road* was originally provided with a "permanent" track. The aggregate trade has not yet reached 300,000 tons net—the reader who feels any interest in such matters can cross the Delaware to Camden, and examine the old rails, and form his own conclusions; he will then be able to judge whether these have given out because they are too weak, or because the material, in this form, is inadequate to a much greater effort.

In *England*, however, it is contended, people have more experience. The *best* experience there, is that of the Liverpool and Manchester railroad, a work which was opened to public use in the fall of 1830. This road was at first supplied with two tracks of edge rails, weighing 35 pounds per yard. The rail answered very well until the fall of 1833, when the work had passed about 300,000 tons on each track, at which period £150 were expended for *new rails.* In the next half year, before they had transported 350,000 tons, an aditional outlay of 3,000 pounds Sterling was required for new rails, and the adopted pattern was pronounced *too light* for the service. A rail weighing 50 pounds yer yard was next tried, and subsequent experience showed that that also was *too light.* A new pattern was then projected, weighing 62 pounds per yard, and forthwith submitted to the same rough usage. The trade on this road is great, and soon tests the merit of fancy. This pattern was also found inadequate, and another, weighing 70 pounds per yard, was fixed upon, which was, *last year*, regarded as the pattern rail. I have not yet heard how it wears, but one year more will test its strength on that road, where there is really a heavy trade, although the net tonnage does not reach one-half, nor much exceed one-third of the average trade of the Schuylkill, or Erie canals. I do not believe that either pattern would resist the action of one year's business of one of those works, if it were confined to a single track.

I trust that those who have made observations on this interesting subject, will communicate them for publication in this Journal. If there be an edge

* It is proper to say that the rails of this road were taken up after six years' use, because they were too weak; but we never meet with rails that are strong enough after they have sustained the passage of 600,000 tons.

rail in the United States, which has sustained the passage of a million of tons of freight,* conveyed by locomotive engines, it could not but be regarded as a most encouraging circumstance, and its history ought to be known; such a rail—weighing 60 pounds per yard—would show the practicability of reducing the average cost of this item, for such rails, down to 6 mills per ton per mile; and, therefore, below any result which I have yet been able to obtain. My impression is, from the comparisons of the actual destruction which I have been able to make, that its value may be reduced, by the adoption of a suitable flat bar, and a moderate speed, to 3½, or 4, mills per ton per mile.

(To be continued.)

NOTES ON PRACTICAL ENGINEERING.—NO. 3.

Railway Curves.

There are two modes of running curves in general use here; by chords and by tangents. In Col. Long's manual, published many years since, the method of chords is adopted; in Mr. Van De Graaff's work a system of rectangular co-ordinate axes is used in connection with the method by chords; in Mr. Mifflin's treatise a geometrical process is adopted, the auxiliary curves being actually traced on the ground and the curve itself traced by the mode of chords; in Mr. Johnson's tables the system of tangents is adopted and the offsets to hundredths of a foot calculated for tangents of from 25 to 200 feet in length, increasing by 25 feet; the angles of deflection and lengths of arcs are also given for tangents of 100, 150 and 200 feet. The offsets are the parts of the secant included between the tangent and the curve, and the angles which they form with the tangents are also calculated. In the "Civil Engineer and Architect's Journal" of 1840 there are very extensive tables of ordinates from tangents from ½ to 5 chains, calculated to the nearest tenth of a foot, but the deflections are not given as the chain alone is used.

Opinions differ as to the value of the different methods. Where the tangents are run out on the ground, a variety of curves may be laid off with great ease from the same tangents, and this is frequently desirable where the ground is so difficult as to require a pretty close approximation to the best line even for a preliminary survey. The following table is taken from the "Civil Engineer's Journal" and, as the use of the Transit is general here, the deflections for tangents of 500 feet have been calculated, so that in its present form it may be often useful to the American engineer.

Table for setting out Curves by Ordinates from Tangents with the angles of Deflection for Tangents of 500 *feet.*

Radii in feet.	Tangents in feet.										Angles of deflection
	50	100	150	200	250	300	350	400	450	500	° ′
500	2·5	10·1	23·0	41·7	67·0	100·0	142·2	200·0	282·1	500·0	90 00
6 "	2·1	8·4	19·1	34·3	54·6	80·4	112·7	152·8	203·1	268·4	79.37
7 "	1·8	7·2	16·3	29·2	46·2	67·5	93·8	125·5	163·8	211·0	71 04
8 "	1·6	6·3	14·2	25·4	40·1	58·4	80·6	107·2	138·6	175·4	64 00
9 "	1·4	5·6	12·6	22·5	35·4	51·5	70·8	93·8	120·6	151·7	58 06
10 "	1·2	5·0	11·3	20·2	31·8	46·1	63·3	83·5	107·0	134·0	53 08

* In a report on Heron's cast iron rails laid before the committee of Science and Art of the Franklin Institute, about two years ago, I stated that no road in the United States had yet sustained one million of tons of freight. I have not yet heard of such an instance.

Radii in feet.	Tangents in feet. 50	100	150	200	250	300	350	400	450	500	Angles of deflection ° '
1100	1·1	4·6	10·3	18·3	28·8	41·7	57·2	75·3	96·3	120·2	48 53
12 "	1·0	4·2	9·5	16·8	26·3	38·1	52·2	68·6	87·6	109·1	45 14
13 "	1·0	3·9	8·7	15·5	24·3	35·1	48·0	63·1	80·4	100·0	42 04
14 "	·9	3·6	8·1	14·4	22·5	32·5	44·5	58·4	74·3	92·3	39 18
15 "	·8	3·3	7·5	13·4	21·0	30·3	41·4	54·3	69·1	85·8	36 52
16 "	·8	3·1	7·1	12·6	19·7	28·4	38·7	50·8	64·6	80·1	34 42
17 "	·7	2·9	6·7	11·8	18·5	26·7	36·4	47·7	60·7	75·2	32 47
18 "	·7	2·8	6·3	11·2	17·4	25·2	34·4	45·0	57·2	70·8	31 03
19 "	·7	2·6	5·9	10·5	16·5	23·8	32·5	42·6	54·1	67·0	29 29
20 "	·6	2·5	5·6	10·0	15·7	22·6	30·9	40·4	51·3	63·5	28 04
2100	·6	2·4	5·4	9·5	14·9	21·5	29·4	38·4	48·8	60·4	26 47
22 "	·6	2·3	5·1	9·1	14·2	20·5	28·0	36·7	46·5	57·6	25 39
23 "	·5	2·2	4·9	8·7	13·6	19·6	26·8	35·1	44·4	55·0	24 32
24 "	·5	2·1	4·7	8·3	13·0	18·8	25·7	33·6	42·6	52·7	23 32
25 "	·5	2·0	4·5	8·0	12·5	18·1	24·6	32·2	40·9	50·5	22 38
26 "	·5	1·9	4·3	7·7	12·0	17·4	23·7	31·0	39·3	48·5	21 46
27 "	·5	1·9	4·2	7·4	11·6	16·7	22·8	29·8	37·8	46·7	20 59
28 "	·4	1·8	4·0	7·2	11·2	16·1	22·0	28·7	36·4	45·0	20 14
29 "	·4	1·7	3·9	6·9	10·8	15·5	21·2	27·7	35·1	43·4	19 34
30 "	·4	1·7	3·8	6·7	10·4	15·0	20·5	26·8	33·9	42·0	18 56
3100	·4	1·6	3·6	6·5	10·1	14·5	19·8	25·9	32·8	40·6	18 20
32 "	·4	1·6	3·5	6·3	9·8	14·1	19·2	25·1	31·8	39·3	17 46
33 "	·4	1·5	3·4	6·1	9·5	13·7	18·6	24·4	30·8	38·1	17 14
34 "	·4	1·5	3·3	5·9	9·2	13·3	18·1	23·6	29·9	37·0	16 44
35 "	·4	1·5	3·2	5·7	8·9	12·9	17·6	22·9	29·1	35·9	16 16
36 "	·3	1·4	3·1	5·6	8·6	12·5	17·1	22·3	28·3	34·9	15 59
37 "	·3	1·4	3·0	5·4	8·4	11·1	16·6	21·7	27·5	33·9	15 23
38 "	·3	1·3	3·0	5·3	8·2	11·8	16·2	21·1	26·8	33·0	14 59
39 "	·3	1·3	2·9	5·1	8·0	11·5	15·7	20·6	26·1	32·2	14 37
40 "	·3	1·3	2·8	5·0	7·8	11·3	15·3	20·1	25·4	31·4	14 15
4100	·3	1·2	2·7	4·9	7·6	11·0	15·0	19·6	24·8	30·6	13 53
42 "	·3	1·2	2·7	4·8	7·4	10·7	14·6	19·1	24·2	29·9	13 37
43 "	·3	1·2	2·6	4·7	7·3	10·4	14·3	18·6	23·6	29·2	13 16
44 "	·3	1·1	2·6	4·6	7·1	10·2	14·0	18·2	23·1	28·5	12 58
45 "	·3	1·1	2·5	4·4	7·0	10·0	13·7	17·8	22·6	27·9	12 41
46 "	·3	1·1	2·4	4·3	6·8	9·8	13·4	17·4	22·1	27·3	12 23
47 "	·3	1·1	2·4	4·2	6·7	9·6	13·1	17·0	21·6	26·7	12 09
48 "	·3	1·0	2·3	4·1	6·5	9·4	12·8	16·7	21·2	26·1	11 54
49 "	·3	1·0	2·3	4·1	6·4	9·2	12·5	16·3	20·8	25·6	11 39
50 "	·3	1·0	2·2	4·0	6·3	9·0	12·3	16·0	20·4	25·1	11 25
5500	·2	·9	2·0	3·6	5·7	8·2	11·1	14·6	18·5	22·8	10 23
60 "	·2	·8	1·9	3·3	5·2	7·5	10·2	13·4	17·0	20·9	9 31
65 "	·2	·8	1·7	3·1	4·8	6·9	9·4	12·3	15·5	19·3	8 47
70 "	·2	·7	1·6	2·9	4·5	6·4	8·8	11·4	14·4	17·9	8 10
75 "	·2	·7	1·5	2·7	4·2	6·0	8·2	10·7	13·4	16·7	7 37
80 "	·2	·6	1·4	2·5	3·9	5·6	7·7	10·0	12·7	15·6	7 09

W. R. C.

THE ERIE CANAL—ITS CAPACITY—LOCKAGES—IRON BOATS.

We were among many who, in 1834–5, were deluded into the belief, after the completion of our present lateral canals, of the necessity of procuring enlarged avenues for the trade beyond our own State, at that period the capacities of railways to convey freight was not fully developed. We adopted and advocated the plan of a large, or "steamboat canal," 8 feet by 90 feet, from lake Ontario to the Hudson, with locks, 30 feet by 130 feet. The plan was to take advantage of the natural waters of the Oswego river, the Oneida river and lake, and from thence by Rome on the north side of the Mohawk river, to the Hudson. The length of this canal was 92 miles to Utica, and from thence to the Hudson 107 miles, total 199 miles of canal, showing a difference of canal, of 213 miles to be constructed, in favor of the Oswego route, compared with the Buffalo route. The natural waters of lake Ontario and Niagara river, 160 miles.

So feasible was the project, and limited the expense, from Oswego to Utica, owing to the use of the rivers Oswego and Oneida, and lake Oneida, 57 miles, the estimated cost was only $1,131,898, demonstrated by actual surveys. Five and a quarter millions were allowed as the cost of the canal to the Hudson Such was its feasibility, that the canal interest became alarmed for the diversion of the western trade by a cheaper channel, and in a reckless manner, rushed into the enlargement of the Erie canal, without regard to party or to its cost. It was truly a *sectional* movement, made without sufficient surveys and examinations, and we are disposed to exonerate the engineers for their estimates, as they candidly said in their report, they had not time to make the necessary surveys. Warnings of the difficulties, and statements, that the estimates were inadequate, were treated with derision. We well recollect being told by the chairman on canals, in 1835, "The policy of the State is decided on, we cannot entertain the subject of seperate canal from lake Ontario, and the use of the Welland canal, or, a ship canal around Niagara Falls, let their merits be what they may, we must enlarge the Erie canal." In consequence, a bill was introduced, *mhich passed without remark!!* giving the canal board full powers to make the canal of any size, pledging the whole treasures of the State to this stupendous undertaking. It was pointed out to the canal committee "that the tonnage of the upper lakes was than actually let down into the lake Ontario, by the Welland canal; that the vessels could be transferred from the lakes to the sea-board, by the improvement proposed, in the fall, to return with loads in the spring; that our fresh water sailors, instead of spending six months in idleness, could be transferred with their vessel to the seaboard, and have employment the entire year; that our lake vessels were particularly adapted, from their construction and light draught of water, to our West India and southern country trade; that 140 miles of canal navigation and tolls would be saved; further, that by the plan proposed we should have two canals, and competition instead of one, and this too for one-third the sum $27,000,000, we then stated (in face of the calculation of $12,400,000)

it would take to enlarge the Erie canal to Buffalo; that by the plan we proposed, we should avoid the interruptions and damages incident, as has proved to be the case of the enlargement; that, to a great extent, we should have to make a new canal in all the difficult places, to enable us to construct the locks, culverts, aqueducts, etc., in the summer."

The "bubble age" with the canal mania of the day has, however, passed, and the truth should be told. It is now well recollected, that both parties had to elect their candidate for the presidency. "The Young Lion of the West," and the majorities beyond Cayuga bridge were to be courted. The project of a separate large canal, from lake Ontario to the Hudson, being frustrated by timid politicians, without a fair arguing into its merits, led us to examine into the necessity and extravagance of making a ship canal out of the Erie canal for the trade of our own State, a canal that only required to be bottomed out, and double locks constructed to Syracuse, this side of the main lateral canals. We discovered this was everything that we wanted for the trade and commerce of our own State, and for the trade beyond us, the Oswego route could defy competition.

We opposed the enlargement from principle; we had not a dollar involved in the question. To ascertain the necessity of the enlargement, we were led to examine, in 1835, into the number of lockages at Alexander's lock, west of Schenectady—the test lock for the business on the canal. We found the average was only one every 12 minutes, during the season of navigation—that in this time the lockages could be trebled. To arrive at the nature of the trade on the canals, the present comptroller, Mr. A. C. Flagg had the goodness to adopt the suggestion, to class the tonnage floated on our canals, under the following heads:

The produce of the *forest*, of *agriculture*, of *manufactures*, of *merchandize*, and of other articles. The tables of 1836 compared with subsequent years, led to the discovery that the produce of the forest which in 1836 was 755,252 tons of the 1,310,807 the whole number of tons that floated on all our canals, fell off in 1842 to 504,597 tons, of the 1,236,931 tons that during that year floated on our canals. During this period, the increase of tonnage from agriculture, and from all other articles, did not make up the decrease of lumber, although the tolls were greatly increased, from the fact, that the tons produced from agriculture, paid four times the tolls paid on the produce of the forest.

The obstinacy with which the enlargement was persisted in, without adequate surveys and estimates, led us to expose the folly of the same. This occurred in 1836, 1837, particularly, after the extension of the Mohawk and Hudson railroad to Utica, and the construction of other railways in this country and Europe, began to develope the capacity of this, truly styled "*better improvement of the age*," to convey freight, as well as passengers at all seasons of the year; and this too, at rates to defy competition on this line by the Erie canal, if properly constructed and located.

We well recollect that such was the mania for canals, that we were laugh-

ed at for our folly in advocating such doctrines, and were considered by many who had not investigated the subject, as fit for a straight jacket. We well recollect stating six years ago, that the Erie canal was not up to one-third of its capacity. This deduction was drawn from the experience of the lockages at Alexander's lock, on the greatest days of business in 1835-6. We then stated "*that further expenditure beyond clearing out the present canal to four feet and making double locks and pond reaches to Syracuse was unnecessary.*" That such was the improvements then making in the paddle gates—and the case was instanced on the Lehigh canal of their passing a boat through a lift of 32 feet in 2½ minutes, while ours were only 8 feet—that from this fact, there could be no question of the capacity of the Erie canal, when improved as pointed out, and releived of its packet, and semi packet boats of emigrants and their baggage, that it would answer the wants of this State for all time to come. That if the western States were to be accommodated, as they should be, and the State to hold the toll gate, the Ontario route should be adopted, as the cheapest.

This conclusion was drawn from the fact, that our lockages in 1835 and 1841, the years of the greatest business did not exceed 12 minutes to a lockage, on an average. We stated, "that there would be no difficulty from past experience, in passing 55,000 or more lockages, instead of 25,998, the number passed in 1835." This number was reduced in 1842 to 22,869 with a continued falling off this year, so as not to exceed on an average, a boat, every sixteen minutes.

Holding these views, and in corroboration of the same, we were gratified to perceive in a late report of Mr. Little, the canal commissioner to the deputy comptroller, Mr. G. W. Newell, that on the 11th inst. at Fultonville, and under all the disadvantages of the cold weather, and as he states "considerable ice in the canal, and snow falling several inches," that 92 lockages were accomplished in 7 hours and 15 minutes being in the ratio of one for every 4⅔ minutes for an 8 feet lift. This is not to be compared with the celerity of lockage on the Lehigh, and on other canals, although there is no doubt but that the ice and snow greatly impeded the operation, or it could have been done in less time.

The above ratio of 4⅔ minutes, would give for the season 71,500 lockages, being more than three times the number of lockages this season, with a large increase of tolls, and capacity of the boats.

With facts of this kind, and yet another, that instead of the capacity of the canal, up to 1841 to float boats drawing 2 feet and 11 inches of water, with a load of only 30 to 40 tons, such is the improvement in the canal, by *bottoming it out* and in the construction of the boats and by the adoption of the iron boats, (which we advocated in your Journal for several years,) that we have now repeated instances of boats loading 60 to 83 tons, drawing three feet of water, the latter load being an iron boat, with Ericsson's propellers. We venture, therefore, little in predicting, that 80 tons to above it, when 3 feet 6 inches water can be obtained, will be the common load for the iron

boat, and further, that the distance from the Hudson to Buffalo, will be accomplished by steam, in one-third the time, now performed by horses, thus again trebling the capacity of the canal.

It should be taken into consideration, that our business has heretofore been performed by single locks. Now we have double locks to Utica, the most crowded part of the canal, and east of all the lateral canals.

We will close with the remark, often repeated, let the railways parallel to the Erie canal have the privilege to carry freight the entire year, even burthened with tolls, or like the New York and Erie railroad, be free to compete with the canal, and our word for it, we may suspend the enlargement for a long period, if not entirely, and save full **$20,000,000** in its prosecution. This will certainly be the case if we include the interest that is lost ere the canal is used during its entire length.

J. E. B.

For the American Railroad Journal and Mechanics' Magazine.

REMARKS ON MR. ELLET'S FORMULA FOR COST OF TRANSPORTATION ON RAILWAYS.

In your November number, there is an article under this caption, by Mr. Charles Ellet, Civil Engineer, who therein lays down certain *fixed laws*, which he further terms simple principles such as cannot well be doubted or denied. Against the validity of these laws we beg to offer some remarks, leaving it to your intelligent readers to decide between us.

1st. Mr. Ellet's law on motive power.

"The cost of motive power with engines of the same class is proportional to the distance which the engines run. The cost per mile is nearly the same on all roads of all grades, the difference in expense on roads with different grades consists not essentially in variations of the cost per mile run, but in variations of the number of miles which must be performed to do the same duty."

Remarks.—The reader should first have some idea of the several items composing the cost of motive power and the proportions which each item bears to the whole expense, which for an example we will state as follows:

Wages of engineman and fireman,	per annum,	$1150	25 pr ct.
Fuel,	"	2000	44 "
Oil, etc.,	"	350	7 "
Repairs of engine,	"	1000	24 "
Total cost of running an engine doing full work, pr an.,		$4500	

Scarcely one of the above items can be called strictly constant, the wages even, which are the most so, will differ with the locality and degrees of skill of the men employed. The fuel, nearly half of the whole cost, is widely different; the price in Georgia is $1 per cord, and 3 and $4 per cord in the middle and northern States, and the *quantity used* depends on the velocity and amount of load, etc. The repairs of engines, these are affected by the quality of the machine itself, of the road it runs upon, the velocity and the skill and care of the driver. Scarcely any two roads are alike in the qual-

ity of their engines. Some are made to run 35,000 miles per annum, and others will hardly perform a third of that work; a fair average of annual work for one engine is from 18,000 to 20,000 miles which she will do at a cost per mile run, varying with the circumstances here enumerated; this variation being as much as 16 to 33 cents per mile or about 100 per cent. The comparative cost of transportation on railways will thus to some extent be affected by the difference in expense *per mile run*, but the real test of their *comparative economy* is at last determined by the *amount of business or load* which is found for every mile which must *necessarily* be run on the respective lines, the disproportion in the miles thus run and the loads carried therewith on different roads, being in general very considerable, whether of passengers or freight, but which, while the expense of running is constant, will be ever changing favorably with the progressive increase in business commonly attendant on the stimulus from railways, and is finally limited only by the power of the engines on the particular grades of the road, the facility of overcoming which, has been of late greatly increased, and thereby the economy of railways. We offer the following instances in exemplification of these positions: thus on the

	Grades	Cost to run an engine per an.	Amt. of net load pr trip.	Total tons per annm.	Cost per ton.	Miles run	Cost pr. mle run
Baltimore & Ohio,	84 ft.	$4500	20	2500	$1 80	20000	22½ c.
Georgia road,	37	3300	40	5000	66	20000	16½
Reading road,	level	4000	160	18000	22	20000	20

The variations are here seen to be scarcely any in the cost of the miles run, but widely so in that of the *duty performed*, going to show that the want of *adequate and regular business* is the real root of all the evils of a railway, and as this business grows upon it, so does it improve in general consolidation and in profitableness. Every one of the roads cited above have improved in both these particulars *with age*, and particularly the first. The Reading road not yet fairly mounted, with as yet *but one foot* in the stirrup, is perhaps the only one using steam in this country, which in *freight* is so lucky as to be worked full up to the capacity of its machinery and grades, and to have both the one and the other of the most favorable kind for profitable transportation, the cost *per ton carried* and *per mile run* being here nearly one and the same, while on most other roads it is *widely* different and the waste immense. Being a practicable thing, we shall soon expect to see the further economy practised on the Reading road, of making the *tonnage carried* at least equal *if not greater* than the *miles run*, that is, an engine running 188 miles should be of the capacity to deliver at least 250 tons.

2d. Mr. Ellet's law on repairs of road.

"The repairs of road, with equal trade, are proportional to its length, that is, cæteris paribus it costs twice as much to keep up a road 200 miles long as it does to maintain one in the same condition of which the length is 100 miles; just as it costs twice as much to run engines 200,000 miles as it would to run the same class of engines 100,000 miles."

Remarks.—It is right to state that the repairs of road are proportionate to its length, that is a *mileage* charge; it consists of two items, the renewal of materials composing the road and the labor of making those renewals and in keeping the track level, the drains free and all other work about the *road bed*, both items will of course be very various on different roads; the one, in the *first cost* of the materials and their exposure to decay on the particular line of road; the other as it may have a firm foundation, easy drainage, freedom from deep cuts, etc. The experience, however, of now some 12 to 15 years applied to efficient roads adequately constructed, enables us to say that the several items of sills, bridges, iron, etc., may be entirely *renewed* by an appropriation of per mile per annum, $300

The important item of labor, the principal source of the after economy of railways, if liberally bestowed, may differ widely, but to do all the work generally required on a fully employed road an annual expenditure per mile will be necessary, of about 350

$650

per mile or $65,000 per annum for 100 miles, as the maximum for *this kind of road*, which will vibrate yearly, but not exceed that sum at its climacterie point of age, which is made up of the average duration of each of its materials, towards and from which point it will be ever either approaching or receding. The common error is to suppose that the *whole* first cost of a road is *again* to be incurred at the end of a certain time, without adverting to the fact that these annual appropriations or intermediate outlays had provided against this contingency, *as necessary*, to insure both safe and profitable transportation over it. That neglect occasionally occurs in this and other respects, as the result of poverty, is certainly true, but where this principle of always keeping the road and machinery up to the *standard of new*, is faithfully attended to, there can be no distinction of old and new roads as made by Mr. Ellet, except as we have already stated, the latter should be *all the better* for their years.

The illustration in the latter part of this law of Mr. Ellet's for road repairs, leads to the inference that they are in proportion to the business done on them; this is not entirely so, the item for renewal of materials may with the increase of business be slightly increased, but that for labor in upholding track, etc., should be nearly as good for 500,000 as for 100,000 tons; and its economy will tell favorably just as the business of a road is large or small; as in the Reading road in the year 1843, the estimate for maintenance and repairs of road is $45,000, which on its tonnage for this year of 250,000, will be 18 cents per ton, while in 1844 with the tonnage doubled, the same item at $50,000 per annum, will not exceed 10 cents per ton. The wear of most of the materials of a railway are now well ascertained, the iron or the principal one, being that about which there is most speculation, enough however is known to establish the fact when the article is good in quality and adequate in weight, that its duration is such, as to make its renewal compassable, after a deduction for the old iron, by a very small annu-

al appropriation; and we are assured that the iron founders derive but *little custom* in England from the annual wear of the iron rails, even there, where the velocity is seldom less than 30 miles with travel and 15 miles per hour with freight. The maximum for the latter in this country is now fixed at about 10 miles per hour. Railways, hardly yet out of the experimental stage, have been gradually working up, in their structure and machinery to the point of adequacy to the duty required of them—more than that would be waste—although the fault here had better be rather a little too much than too little. Till tately the road had to do everything for the locomotive, now there is a reciprocation of favors between them, and the latter can adapt itself to almost any strength of structure with increased power instead of losing any of it. This may well be termed a *compound stride*, in this new, useful and indispensable system of conveyance.

3d. Mr. Ellet's law for repairs of cars.

"The repairs of cars are proportionate to the number of tons conveyed and to the distance to which they are conveyed. It costs twice as much to repair cars which run two millions of miles as it does those which run one million of miles per annum. Again, it costs twice as much to repair cars which convey 20,000 tons as it does those which convey 10,000 tons a given distance. The same principle applies equally to the conveyance of passengers; it applies also to accidents, incidentals and contingencies, for these increase with and are proportional to the increase of business."

Remarks.—The repairs of a car whether passenger or freight, will of course be in some proportion to the work it does, that is, under equal circumstances and quality of article. Tha car itself and the treatment of a car is very different on one road and another, arising principally in the character of the road itself, if a flat bar or an edge railroad, its proper adjustment, and the use more or less of breaks as required by the undulations of the road, these twist a car and subject it oftener to jerks and concussions, and then the expense of attendance; on some roads the breaks may require one man to every three cars, on others one man to every twenty five; his wages of $300 per annum are in one case $100 per car, in the other only $12, this, however, has nothing to do with the repairs, but shows one of the expenses of heavy grades.

We find in England pasenger cars doing full work are repaired at a cost of 5 to 6 per cent. per annum on their cost, and in this country with roads generally inferior, 6 to 8 per cent.; freight cars doing rougher work but at a less speed are renewed from 10 to 15 per cent. on the cost, against all casualties and giving them full employment. The reasonableness of this charge will appear when it is considered of what a car is composed and the value about it to be renewed. Let us take a Reading coal car, these at present cash cost of the items, have $120 of iron and $40 of wood on them, or $160 in all. Iron castings which formerly were 5 to 6 cents per lb. are now 2¾ cents per lb. from which the old material at 1 cent per lb. would remain to be deducted; the wooden portion of this kind of car is now turned

out very cheaply by machinery. Here, then, is but a trifling value of the most perishable part of it to replace. Say this car delivers 300 tons per annum, which at 8 cents per ton, the estimate of the superintendant of the Reading road for repairs, is $24 per annum, or just 15 per cent. on the value, and this is to include all casualties as the damage from *mere running over the road* is scarcely an appreciable item. A double track now in preparation by this road will result in much economy on this item, and it is accordingly expected to be reduced on that event and other developments in management, which come only with time and experience. That accidents are necessarily proportional to the increase of business on roads is not in accordance with either the practice of this country or England, a large business always affording the more means and increasing the skill, for their avoidance.

These remarks in their specific application, will, we trust, for the sake of railways present and to come, do something towards overturning these laws of Mr. Ellet, but in order the more fully to do this, we here give his "formula," of which these laws are the basis, and compare it with the actual results on the Baltimore and Ohio railway, as given with much distinctness of detail in their recent report for 1843, a feature much to be commended and which we like to see practised in future by all railways of any note, seeing the good that it has done the cause in this instance.

FORMULA.

	For new roads under 4 years old.	For old roads over 4 years old.
For repairs of road, for every mile of road,	$300 pr mile.	$500 pr mile.
For every ton conveyed one mile,	9 mills	14 mills
For every passenger carried one mile,	7 "	7 "
For evey mile travelled by the engines,	24 cents.	27½ cents.

RESULT ON THE BALTIMORE AND OHIO RAILWAY IN 1843.

The report gives 509,000 miles as travelled by the engines at a cost of,	$95,936	
The formula for old roads is 27½ cents per mile,	137,430	—41,494
or a variance from actual practice of 43 per cent. on this item.		
The report states the freight trains to have carried a tonnage equal to 7,034,310 tons carried one mile for, (or 4 mills per ton,)	$28,381	
The formula gives a mean cost for old roads of 14 mills,	98,480	—70,099
or a variance from actual practice of 240 per cent on this item.		
The report states the repairs and maintenance of road for 178 miles, at per annum	$100,000	
The formula gives a mean for old roads of $500 pr mile,	89,000	—11,000
or a variance from actual practice of 12 per cent. on this item.		

What annihilation is here, in this "formula" of itself, to the railway system, but lest this should not be enough, he has a "corps de reserve" in freshets, tornadoes, and incendiaries, under the name of "extraordinary expenses" not included in the formula, which, according to him, will finish what

the "formula" may have spared. But Mr. Ellet has deceived himself by the confidence he has so innocently placed in railway reports which are in general notorious for their indistinctness of detail and otherwise inconclusive character for any such purpose as *just* comparisons. In this way he has been led into the mistake of calculating against the *well established rule* with railways, that their expenses are in an inverse ratio to their business—that is, the latter being large, the former will be comparatively small. Moreover, and finally, laws of this character to be good for anything should be uniform and invariable; the railway therefore, if these properties belong to Mr. Ellet's laws, should be *stationary,* instead of which, it has been and still is *most progressive* in the character of both its own structure and its appurtenant machinery, as evinced in the recent and last improvement by Baldwin and Whitney, in the locomotive, so truly termed the *main spring* of this system, and by which the light flat bar road has been saved from condemnation. The most of our railways have been sickly only from insufficient business, and it would be unfortunate indeed, could Mr. Ellet establish that *full work* the panacea to which they look confidently for recovery will be their certain death; a fate which all good men should deprecate, in the case of works so beneficial in their effects. F.

For the American Railroad Journal and Mechanics' Magazine.

NOTE TO ARTICLE ON "CANALS OF CANADA."

(See Railroad Journal for November, 1842.)

Important events which have occurred during the last year, require notice, in order fully to comprehend the "prospects" of these canals on so gigantic a scale. Their failure was based on the absence of that general information and high character which are to the projection what mechanical skill is to the execution of a work. The latter is necessary to the assistant—to the engineer who aspires to success both are indispensable. The earth work and masonry of canals are well understood by the American engineers and their Canadian assistants under whose superintendance these canals are placed; and it can scarcely be doubted, that they will be respectably executed. But no excellence of workmanship can compensate for radical defects in the projection.

It was observed (page 258,) that

"That portion of the western trade which seeks a foreign market via the St. Lawrence, is attracted by political rather than natural or engineering advantages, and, to this extent, does not come within the province of this Journal."

Still it may be observed that the present Canadian and British duties are 4*s.* per quarter of wheat or 12 cents per bushel, in place of the old sliding scale of from 1 to 5*s.* per quarter, which had averaged 2*s.* or 6 cents per bushel. The western trade has been very heavy this year, but the trade of the St. Lawrence has not increased. This is owing more to the losses under the old system than to the slightly increased disadvantages of the new tariff.

The locks of the Welland canal have been increased to 150 feet in length, the better to accommodate the "propellers," a class of vessels the writer ventured to predict, (Journal, April, 1842,) could scarcely fail to come into gen-

eral use. This was done principally on account of the representations of forwarders from Oswego, who have derived much and will derive still greater benefit from the Welland canal. Indeed this work may be considered rather American than Canadian, and this feature will gradually increase, rendering the canal ultimately able to support itself.

Speaking of the down trabe it was said, (page 259,)

"The down trade is by the river, about 200 miles, barges and small steamers running direct from Kingston to Montreal. The draft of water is limited by the depth of the "Cedars," where, at lowest water, a vessel cannot pass, drawing more than 4 feet, to 4 feet 2 inches. It must be observed that nothing has ever been done to improve the down trade of the St. Lawrence, and, the writer believes, that a sum not exceeding £20,000 cy. would give 5 feet water at lowest water in the Cedars, besides less important improvements, such as removing boulders, placing buoys, etc., at other places."

During the last summer, a new and deep channel has been discovered in these rapids. This is a most important and remarkable discovery, leaving little to be desired as far as the down trade is concerned. The almost certainty of the existence of such a channel was pointed out to the writer in September 1842, by Mr. McPherson Jur., a member of the principal forwarding house in the Province—while descending the "Cedars" in the steamer "Juno," Capt. Marshall, who was the first to show its practicability. Had this been achieved by the Board of Works it would have been considered, and not without reason, as entitling them to the lasting gratitude of the country; the press would have been unable sufficiently to commend their merits, and even the thinking few, who see the inevitable result, would have been forced to confess, that this happy discovery would do much towards compensating the immense and permanent injury inflicted by the Board on the Province.

It can scarcely be considered an exaggeration to say, that this channel has been found in spite of the Board who had utterly neglected and in fact discouraged every attempt to aid the improvement of the rapids. Thus, so late as 10th Oct. 1842 it was pronounced by he chairman of the Board, Mr. H. H. Killaly, as "a dangerous navigation requiring the expensive protection of insurance," though this was only three-eighths of one per cent. or not quite 2 cents per barrel of flour from Kingston to Montreal through the *old* channel of the Cedars where losses were principally sustained. Yet this trifling charge was more than sufficient to cover the risk even *then*, and Messrs. McPherson, Crane & Co. were their own insurers.

As remarked in the article to which this *note* refers, "the down trade is indeed the only *great* consideration;" yet was the chairman of the Board an "engineer of great experience and scientific acquirements," ignorant of the risk attending the downward navigation of the St. Lawrence which is of course accurately measured by the rates of insurance based on the experience of many years. This element is indispensable in projecting a canal which is to supersede the use of the river for down freight. The very first point which would have arrested the attention of an engineer acquainted with the western trade and not "a stranger to the country" is, obviously the downward navigation of the St. Lawrence; yet the forwarders of Canada,

unlike their more fortunate brethren of Oswego, failed in drawing the attention of the Board to their representations of the vast benefits which a very slight expenditure might effect in the navigation of the rapids, more especially in the "cedars." The Board appear to have entirely overlooked "the part of Hamlet," till the new channel at last made even *them* understand that the down trade must go by the river. It is scarcely necessary to observe that this had been long known to every one else at all acquainted with the trade and navigation of the St. Lawrence.

The enlargement of the Lachine canal, the locks of which are now 20 by 100, will give the "coup de grace" to the only successful canal the Province has owned or will own till the Welland canal shall clear expenses and interest; a period many years distant. Upwards of 60 tons have been repeatedly carried on the Erie canal, less than 4 feet deep, with wooden boats. An iron steamer took 83 tons of freight from Albany to Oswego passing through locks 15 by 90. Boats filling locks 100 by 20 and drawing 6 feet water will be about equal to boats filling the locks of the enlarged Erie canal will which are 100 by 18, though they are decidedly superior in proportions to the latter. Since the "Cedars" no longer limit the draft these boats can always descend the St. Lawrence, and the present facilities of the down trade by the river—without any cost beyond part of the trifling amount of insurance—are more than equal to the utmost advantages anticipated from the enlargement of the Erie canal, to be executed—if ever—at an enormous cost and not to be attended with any *reduction* of tolls, though inflicting a direct tax on the State of $600,000 per annum.

The St. Lawrence canals depend therefore on the up freight and this was at last admitted by the chairman of the Board in parliament. Now the absolute amount and rate of increase of the western trade are well known, and the probability of the small portion of that trade, going via the St. Lawrence, increasing to an amount sufficient to pay the interest on four millions of dollars from the tolls on 36 miles of canals, besides repairs and superintendance, is too remote to have any interest for the present generation.

Judging from the dilatory proceedings of the Board in completing the Chambly and Cornwall canals (as far as canals in that climate may be considered to be completed without protection wall on the inner slopes) the writer does not believe they could in any circumstances fulfil their promises as to time; judging from the actual cost of works in Canada he does not believe the Province has the means of completing these short canals; and judging from this determination to enlarge the Lachine canal he does not believe the Province will, at the end of ten years, be able to point to a single successful work. In the case of the Lachine canal they are literally carrying out the views of Dean Swift's philosopher, whose highest ambition it was to confer on his country a race of sheep without any wool.

The expenditure of large sums in different parts of the Province necessarily gives a certain degree of popularity to the Board, and the promises which are made as to the early completion of the St. Lawrence canals plea-

se those who believe they will increase the trade of the country. It is therefore the time when the views of the writer are least likely to find favor in Canada; consequently the period the most honorable to bring them forward. They remain as given a year since in this Journal.

It would be difficult to find a more brilliant proof of the immeasurable superiority of private enterprise over governmental attempts. The latter with immense expenditures accomplish nothing useful and will be remembered only by the taxes imposed to pay the debt—the former present freely to the public a vast benefit, which their own common sense had led them to suppose attainable, and which their own skill, energy and resources had triumphantly demonstrated to be so.

New York, Nov., 1843. W. R. Casey.

For the American Railroad Journal and Mechanics' Magazine.

CROTON WATER PIPES BURSTING.

Since the previous article was written, (see number for October) I have tried a series of experiments on the subject; being desirous to arrive at a just conclusion, which results were as follows.

When the faucet was as large as the pipe to which it was attached and full open at the discharge, there was no pressure at the end of the faucet acting to burst the pipe, except the friction of the water in its passage; this shows that if the pipe is burst (which it is) by suddenly shutting off the water alone.

I also tried in my series of experiments on this subject, shutting off the current of water at about 40 feet from the end of the pipe, which end was the discharge, this produced about the result or jar in the pipe beyond the faucet, though by a different mode, as if shut off in the ordinary way with a pipe 40 feet long, this pipe I tried both straight and with a number of bends, or serpentine in form, the straight pipe had but one jar or "blow," on shutting off the water, but the bent or serpentine form had as many jars or "blows" in the pipe as there were bends; these were caused in this way, the impetus of the water in the straight pipe, beyond the cock was in motion after the faucet was shut, which still proceeded as long as the impetus so given lasted, forming a vacuum between the stop-cock and the end of the water in the pipe, which returned with a "blow" which was the "water hammer," whose operation was the same as explained in the before mentioned article; when the pipe was bent the blow or jar was less heavy on each part, but amounting to the same in the aggregate, the blow nearest the cock was the heaviest, and they decreased gradually at each bend or turn according to length of each junction, towards the end of the pipe, all striking successively on the return of the water.

Glass pipes have been proposed and tried in Europe for conducting water but have not been applied here, to the writer's knowledge; from some experiments on glass I am of the opinion, that from it being almost non-elastic it could not be applied where stopping the water would jar or strike it, as it

breaks very easy under such circumstances, but will stand an enormous dead pressure.

Glass varies much in its strength under different circumstances, as the least change by heat or cold *unequally* applied will weaken it much and if extended sufficiently will break it. It is true iron is affected in the same way, after repeated, unequal, very high heating, and then cooling, as we see by gas retorts, stoves, etc., after use.

History relates an invention by which glass was made that could not be broken; this cost the inventor his life, by being thrown off the scaffold from which his glass was dashed but did not break; we want such glass for Croton water pipes.

Many a man's invention in these times, costs him *his life*, or *its equivalent, his all.* You will hear from me again on some other subject soon.

New York, Nov., 1843. CIVIL ENGINEER.

ACCIDENTS UPON RAILROADS.

Messrs. Editors.—The reader was made acquainted in our last number with the regulations in *England* excluding cattle from railroads, and with the safety to which those regulations had contributed. How long are we to wait for the adoption of similar regulations here, where they are more needed, the mischief being more imminent? The triumphs of human genius over the elements are daily advancing the march of civilization, and adding to the comforts of the human race; and though it might be presumptuous to doubt that the power of steam has been given to us for ultimate good, it may well be questioned whether the public authorities are warranted in sending forth an agent of such tremendous effect without adequate safeguards. The application of this new power on water and on land is the great invention of the age.

Railroads, and the speed of which they are susceptible, have become as indispensable to all classes of our population as any of the old modes of locomotion, and the convenience and interests of the public will neither admit of abandoning the one nor reducing the other. Therefore, if from collisions arising from obstructions upon the road, these improvements are not only to lose much of their utility, but be made eminently dangerous in their operations, it becomes the duty of the legislature to take the subject into its hands, and, following the lights of experience, apply the same remedies here that have been found both indispensable and effectual elsewhere.

That degree of safety which by possibility can be attained by the most judicious management upon the part of railroad companies, and by the utmost care and caution of their agents, ought to be first insured; but if experience prove these inadequate, the obligation to provide further safeguards becomes not less imperative. To accomplish the first there certainly has been no want of rigor in those who make the laws. Towards the railroad companies and their agents the penal code of Maryland is marked by the utmost severity. Although the operations of their roads yield little or no profit, railroad companies are required to spare no expense in keeping their works in thorough repair; to provide the best and most approved system of machinery, and adopt every proper improvement which the effort of genius may suggest, even under the heavy exactions of their inventors, and to employ the fullest complement of agents of competent skill; and from all persons in any way engaged in the operations of the works the utmost care and

caution which the highest capacity can insure is rigorously enforced. Not only so; but here, in this State, the wise, humane rule of the common law, which presumes innocence until guilt be proved—the great shield interposed by justice against wrong and oppression—is completely inverted. In the case of injury to person or property, arising from an accident on a railroad in Maryland, the law directs the civil magistrate to take it for granted, without any proof whatever, that the casualty happened from the fault of the company or its agents! To presume that an engineman has carelessly thrown the sparks from his engine into a neighboring barn, or heedlessly, and at the risk of his own safety, run his engine into an animal on the track, and to punish him accordingly—unless, by some other testimony than his own, which from the nature of the case is seldom at hand—he should be able to prove that the accident was unavoidable. We think the reader will not only pronounce this to be in all conscience enough, but will be apt to consider it an inversion of all the rules of deduction from evidence, by which we usually form a judgment of human conduct. In my view it would require only a small spice of injustice or prejudice in the magistrate who is called to execute the law, to assimilate it to the iron rule of the despot of Prussia, which doomed a soldier to be shot, if, while on parade, his hat should be blown off by the wind.

Let it be conceded, however, that this degree of severity is, under the circumstances, necessary, and therefore justifiable. Why is it necessary and justifiable? Surely the public authorities do not mean to treat those who have, at a heavy expenditure of capital, introduced these new works and adapted them to the wants of the public, as guilty of improper conduct, and therefore objects of vindictive justice! In sanctioning their enterprizes, the legislature sent them forth as the projectors of beneficial improvements, themselves the objects of the countenance and protection of the law. Bound, no doubt, to exert their utmost care to prevent injury to others from the dangers incident to their enterprize; but entitled, in common with the public, to be guarded against hazards, produced by the wantonness or carelessness of others, which no care of theirs could avoid.

It is to be supposed that the legislature is under no obligation to afford the public other security against accidents on railroads than the imposition of penalties upon those managing them? To say to the survivors, in case of death, or to the man who may have lost his limbs or his property, look for remuneration to the railroad company? Money, severe as the penalty may be upon the company, does not always afford adequate remuneration for such injuries; it seldom mends a limb; it never restores life; and in the majority of cases can make no atonement whatever for its loss. What the public want, and what the nature of the case demands, is *preventive* measures; those which *preserve* persons and property from injury, rather than such as leave them exposed to loss, and attempt, after it is suffered, to make compensation for it.

On no other ground can the penalties, already adverted to, against the railroad companies and their agents be excused, and much less justified. They are designed, and in this respect entitled to commendation, to exert the force of the penal power to insure the utmost care and skill and providence upon the part of the companies to guard against mischief, and thereby afford all the security which in this way can be given—nothing more. The grievances, or omission, or whatever else it may be called, as we think, is, that the legislature seem to have proceeded upon the idea that the railroad travelling was exposed to no other risks or danger than those which might arise from the negligence of the companies or their agents, or that these could ac-

complish impossibilities; and have thereby left the most ordinary source of danger unguarded. Let the case be supposed, that an animal, emerging from its concealment by the side of the road, suddenly comes upon the track, within ten yards of the locomotive, attached to a train of four or five cars, containing more than one hundred passengers, and proceeding at the rate of twenty or fifteen miles per hour; at twenty miles, the engine would run the ten yards in a single *second* and at fifteen *in a second and a quarter!* In a second and a quarter of time, it would be manifestly impossible to let off the steam, reverse the engine, and apply the breaks—much more to stop the train! The collision takes place and limbs are broken or lives lost. Under such circumstances, if any one should be unreasonable enough to bring suit the magistrate who might be selected to examine the case, whoever he might be, if not grossly corrupt, would find himself compelled to exonerate the railroad company and the agents. If he did otherwise, he would afford no security against the recurrence of a similar casualty. Now, then, here is a danger, and one of almost daily occurrence, against which neither the company nor the public have any security whatever. It may be observed, moreover, that in the case supposed, the result would not have been different, as it respects the collision, if the animal had been *fifty* instead of *ten* yards in front of the engine.

Now, if there be only a single class of obstructions, and that of frequent occurrence, which it is impossible for the railroad agents by any care on their part to avoid, against that the public have the right to demand the requisite protection. We have been able to conceive of no other likely to be effectual than an explicit law making it the duty of all to *clear the track.*

But there are more than one class of obstructions equally perilous, to which we may refer in another number.—*Balt. American.* T.

Messrs. Editors.—We have already spoken of the speed of railroad travelling, and of its importance to the public. In the further investigation of the subject, however, we think that this part of it ought at no time to be lost sight of. In truth, the capacity to transport the greatest weights, at the least cost and highest velocity, constitutes the chief object of the improvement. It is this which has enabled it to supersede at once the ordinary modes of conveyance—has impressed its influence upon the present age, and is destined to produce even more wonderful effects in the future. While on the water, the power of steam has diminished the size of our rivers, and contracted the ocean itself to less than half its breadth, the same agent on the land has leveled the loftiest mountains, and gone far to annihilate those distances which previously separated the various parts of our continent. In this country the effects, social, moral and political, are not to be overrated. While most of the other nations of the globe are reaping the benefits of the centralization resulting from the power of steam on water and on land, we could not if we would, creep along at the old fashioned pace; but when we come to contemplate the consequences of bringing all parts of this vast empire within a few day's journey, and of uniting their population in one great family, we will be apt to desire rather to augment than diminish the power of the locomotive.

Now, the cheap transportation of the greatest weights at the utmost attainable velocity, is to be produced, under the lights of science and the guidance of experience, by the power itself; but that degree of safety which is to give the grand result, must be looked for to the interposition of the lawmakers; and we repeat that the measures adopted for this purpose should have reference to the nature of the improvement, and to the character of the risks. They should be applied with enlarged views and bold hands. If

we mean to master the elements and render them subservient to our daily wants, we must do it effectually—we must suffer no stale usages, or unreasonable privileges to stand in our way, or weaken our dominion.

Bearing these considerations in mind, let us pursue the tenor of our remarks. It appears, by the report of Mr. Stevenson, that in 1838 the average speed of railroad travelling in *England* was thirty miles an hour; which, in the communications attached to the appendix to the report of the Irish railway commissioners, was regarded as a mere *starting point.* Able commentators upon that report confidently anticipate, from improvements in the railway and machinery, a speed of from 60 to 100 miles an hour, and of such rate predicate the ultimate advantages to be expected from the introduction of railroads. In the same year, as appears from the same report, upon railroads in the United States, at that time comprehending a distance of 1600 miles, the average speed was stated at fifteen miles an hour. Since that period the extent of railways in the United States has not only been considerably increased, amounting at present to not less than 3,000 miles, but we have acquired the means of a greatly accelerated velocity. In numerous instances, too, they have been adopted as post roads, and it may be safely assumed, from this cause, that the competition among railroads, that upon all the principal lines, and especially those employed in the transportation of the mail, the average speed is not less than twenty miles per hour; and to attain that aggregate velocity upon a long line of road, the train upon many parts of it must proceed at a still greater speed. In the reports to the English parliament, to which we have already more than once referred, it is estimated that at a speed of thirty miles an hour, a train cannot be stopped in less than two hundred yards; and in our first paper we ventured to assert that in this country, at a speed of twenty miles, a train could not be stopped in less distance than one hundred and fifty yards. Whether we are right or wrong the reader may, with a slight examination, entirely satisfy himself.

An engine and train, at the rate of twenty miles an hour, may be stated to run six hundred yards in a minute, ten yards in a second, and one hundred and fifty yards in fifteen seconds, or one quarter of a minute. To stop a train it is required not only to shut off the steam, but to reverse the motion of the engine, and apply the breaks of the cars; and for these purposes, ten seconds may be stated as the least possible time. But during these ten seconds the engine will have run one hundred yards, according to all experience, a heavy train at the rate of twenty miles an hour, under circumstances the most favorable to resistance, will continue its motion, though doubtless somewhat reduced, for at least ten second more. If its velocity should be reduced one half, it would require the whole space we have supposed.

It is to be observed, moreover, that the space in which a train may be stopped, is dependant not only upon the weight and speed of the train, but the grade of the road, and often varies from one-eighth to a quarter of a mile. We have been present at an experiment made under the most favorable circumstances, with a train not exceeding the usual weight, and proceeding at a speed of less than twenty miles an hour; and we saw it very clearly demonstrated that with the readiest application of the appliances, such a train could not be stopped in less than one hundred and fifty yards. If the fact be at all doubtful, the legislature have it in their power—and in a case of so much importance it is surely their duty—to ascertain its truths. In the mean time we will proceed upon the hypothesis now proved.

It is clear, then, that if obstructions be found upon the track of a railway at a less distance than one hundred and fifty yards from the engine, no degree of care nor skill nor power upon the part of those in charge of the train

can, by possibility, prevent a collision. When the reader reflects upon the frequent occurrence of obstructions from cattle on the road within even a less distance, he cannot fail to require that some further security should be provided against the consequences to which they too surely lead.

We profess to be somewhat familiar with the operations of railroads. Our attention has been often drawn to the subject, and we have sought information in regard to it from all sources within our reach. We have, too, frequently had occasion to examine particularly into the circumstances attending casualties of almost daily occurrence; not only to detect, and if found, to punish negligence, but to discover any possible means by which a recurrence of the evil could be avoided.

Of the numerous accidents arising from cattle found upon the track, we are not aware of a single instance in which the collision has happened when it was possible to discover the animal within one hundred and fifty yards of the train. On those roads with which we are more particularly acquainted, we may state positively that no such instance has occurred. Indeed, it may be affirmed, that such collisions most frequently occur where the obstruction is found within a distance varying from ten to fifty yards than at any other; and in all the cases that have come under our observation the persons in charge of the train have freely risked their own lives to prevent harm to those exposed in the cars. Although the public on such occasions are apt to think only of the safety of the passengers, overlooking the fatal injuries often inflicted upon the humbler parties, we confess we have come, after much observation, to give a wider range to our sympathies; and to include within them those agents hourly, and in case of collision, inevitably exposed to disasters, which in a moment, may reduce their families to want. We have come to regard the conductors, and enginemen, and firemen of the trains as we do the adventurous sailor, who exposes himself in all weathers and risks his life upon the frailest spar or the slenderest rope to preserve the comfort and safety of the inmates of the ship; and we think that in legislating upon this subject, no humane statesman would overlook the protection justly due to such men. Now, as far as our experience goes, collision with cattle found upon the tracks of railroads may be said invariably to arise in one of the following cases:

1. Where the animal is found at night lying between the rails, and, in most instances, not discovered until actually entangled in the train.

2. Where the animal suddenly comes upon the track at night, or in the day time, from the bushes on the side of the road, and within a short distance from the locomotive.

3. Where, being on the track, but hidden from the view of the engineman by a curvature in the road, cannot be seen at a sufficient distance to enable him to avoid the collision.

These risks, it will be seen, afford ample room and space for fearful injury to life and limb, *against which, the law, as it now stands, makes not the slightest provision.*

In another paper we may refer more particularly to the most serious accidents which have arisen under one or all of the heads above stated.—*Baltimore American.* T.

ADVANTAGES OF THE FORM OF RAIL AND STRUCTURE OF THE PHILADELPHIA AND POTTSVILLE RAILROAD.

In designing the parts of a new work, it is the duty of a skilful engineer to study the peculiar circumstances of the case, and proceeding from known laws and well ascertained facts to produce such a plan as can with certainty

be predicted to answer the desired end. In most cases, the trial of direct experiment, under all the given circumstances, is quite out of the question, particularly when *time* enters as an element into the calculation. All that can be done therefore is to make use of such experiments, or rather, of such experience as shall approach nearest to the case in point. In applying these principles to construction in general, and in particular to railroad construction, it is evident that there must be wide room for the display of that sort of discretion which mainly contributes to the formation of professional skill. When time has confirmed the predictions of the engineer, the case may fairly be quoted as experience in future works—and the careful examination this experience of works constructed upon our own soil, and therefore adapted to our peculiar wants, will in course of time form the most valuable part of professional information. It is therefore the duty of every one to present either the result of his own labors, or his observation on those of others, to contribute to the common stock of knowledge.

A period of four years having elapsed since the completion of the Philadelphia and Reading railroad, with a heavy traffic for the greater part of that time, we feel enabled to speak with some confidence as to the merits of the mode of structure employed upon that work. No description in our own words could be more full or accurate than that given by Messrs. Knight and Latrobe, in their celebrated report on the forms of rail and superstructure in the United States. This description, it will be seen, was written before the completion of the work; we have however allowed the first paragraph to stand, as identifying the time, and as showing that it contains no after thoughts.

PHILADELPHIA AND READING RAILROAD.

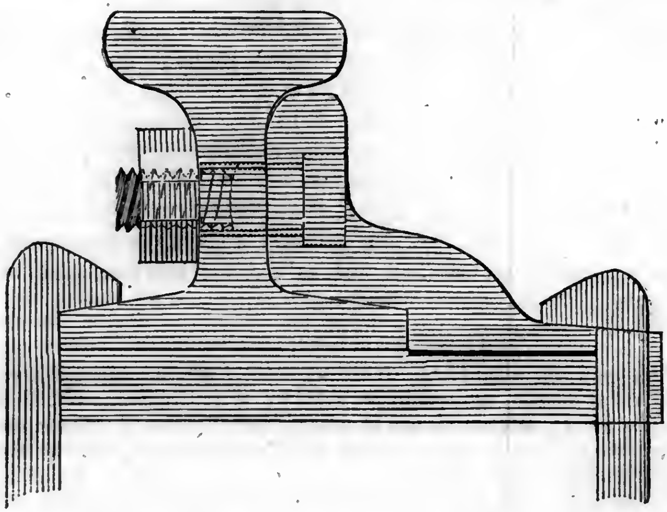
This road was planned by, and is under the general superintendence of Moncure Robinson, civil engineer, aided by Wirt Robinson, Wilson M. C. Fairfax, W. H. Wilson, James H. Grant, and Thomas P. Huger, assistant engineers—and is not yet completed. It is intended principally for the transit of the anthracite coal of the Schuylkill to market, upon the Delaware, at Philadelphia, and will extend from the coal region down the valley of the Schuylkill, at grades varying from a level to descents of 19 feet per mile in a direction from the mines, with the exception of the pass from the Schuylkill to the Delaware, where an ascending line from the former river to the summit of the divide, of 40 to 50 feet to the mile, will be admitted, upon which assistant locomotive power will be employed.

Plan of construction.—The H rail is employed, weighing 45⅛ lbs. per yard lineal; each bar is 18¾ feet in length, with square ends, and weighs, on an average, 282 lbs., or 8 bars to the ton. With exception of the square ends, the form of the rail resembles that on the Washington branch of the Baltimore and Ohio railroad, except that is 5⅛ lbs. to the yard heavier than the latter.

The rail is laid upon the white oak sleepers, or cross ties, 7 feet in length and hewn upon the upper and lower sides, so as to have a flat surface for the under bearing, and a similar one for the rail to rest upon of 8 inches wide; the depth of the sleeper being 7 inches uniformly. These are laid 3 feet 1½ inches apart from centre to centre, and cost, upon an average, delivered

at distances apart of about two miles, on the graded surface of the road, about 60 cents each. Timber is scarce and dear upon the Schuylkill, and it was said that these were brought by the Union canal from Huntingdon county. Each sleeper is laid upon a prism of broken stone, deposited in a trench 14 inches deep, 12 inches wide, and 9 feet long, transversely of the line of the track. The cost of broken stone was, on an average, (for this the first track) $1 10 per perch of 25 cubic feet, delivered in heaps 10 feet apart on the road surface. Two sizes of broken stone are used, the one to pass through a two inch, the other through a three inch ring, the larger of which constitute the lower portion of the mass. The stone were placed and compacted in three different layers, one upon the other. The spaces between the sleepers are filled with clay, or any material most convenient to be obtained. This filling reaches to the top surface of the sleepers in the middle of the track.

Every sleeper, (except where there is a chair,) is notched to a depth of about one-fourth of an inch, to receive the lower web of the rails. These notches cost 5 cents per sleeper, which is not included in the 60 cents above mentioned.



Of the *fastenings*, it may be observed, that the rails, at their joinings, rest upon cast iron chairs, let into the sleepers by means of notches cut for that purpose. The chair is 6 inches square at its lower surface, where it is five-eigthths of an inch in thickness. Upon that side of the chair situated upon the outer side of the track, and upon the entire length of the chair, there is a portion of the casting having an upward projection, and passing over the lower web of the rail upon that side, and thence to the stem of the rail; and also extending to, or very nearly to, a contact with the under side of the *upper* web. Through this upper projecting part of the chair, there are two square countersunk holes, to receive square bolts, with heads formed to fill the countersunk holes: each bolt passes through one of these holes in the chair horizontally, and likewise through a hole in the stem of the rail, near its end. The hole in the rail, however, is not precisely square, as it is in the chair, but is $\frac{3}{4}$ by $\frac{7}{8}$ of an inch, and situated at a clear distance of $\frac{3}{4}$ of an inch from the end of the rail. The hole in the chair is for a bolt $\frac{5}{8}$ square,

and the head of the bolt to fill the countersink, is $\frac{15}{16}$ square. Upon the inner side of the rails, a nut screws upon each bolt, to hold the ends of the two rails to the chair, and in proper line, while the hole in the rail is wider than the bolt to allow for contraction and expansion from change of temperature. The bolt and nut weigh 7 ounces, and the chair $10\frac{1}{2}$ lbs., and is held in place by means of 4 spikes, the heads of which pass over the edge of the chair, while their stems are driven into the sleepers, and also fill recesses left for that purpose in the corners of the chairs in casting them. The same kind and size of spike is used to fasten the rail to each sleeper, (except where the chairs are) the head of the spike passing over the edge of the lower web on each side of the rail. The spikes are 6 inches in length, and their stems are $\frac{3}{4}$ by $\frac{5}{8}$ of an inch, and they weigh about $\frac{3}{4}$ of a lb. each. It is thought that the stem should be square, and the length $4\frac{1}{2}$, or at most 5 inches.

The varied cost of the iron rails at Philadelphia, averaged about $60 per ton. And the cost of the conveyance to the road, by means of the Schuylkill navigation, was $2 60 per ton.

There are in the mile of track,

Bars of rails, in number	563,	weighing	71	tons.
Chairs, do.	563,	do.	5,910	lbs.
Spikes, do.	7,882,	do.	4,524	"
Screw bolts & nuts, do.	1,126,	do.	481	"
Sleepers of wood, do.	1,689.			

It was stated by W. M. C. Fairfax, (from whom most of these details were received,) that the track cost an average rate of $1 50 per sleeper, or $2,533 per mile, exclusive of the cost of all the iron materials, at Philadelphia.

The cost of *laying down* this single track of railway, consisting of excavating the trenches to receive the broken stone—putting down the broken stone—laying, notching, and adjusting the sleepers—putting on the chairs and the iron rails complete—*has been, on an average,* 40 *cents per sleeper*, or $675 60 per mile of track: to which W. M. C. Fairfax would add, for contingencies, such as cutting the iron bars, in order to make the joinings of each two have a position opposite to the middle of the length of the opposite rail, or bar, (this being a condition uniformly observed in the track) extra transportation, cleaning the side ditches, making crossings, etc., say about $200 per mile.

The above mentioned 40 cents per sleeper, or $675 60 per mile, is included in the aforesaid $1 50 per sleeper, or $2,533 per mile. The contracts for laying down the railway were made at so much per sleeper, viz., 40 cents, as above.

The entire cost of the single track, as laid, is stated by Moncure Robinson to be $7,617 per mile, inclusive of materials and workmanship.

We have omitted the cut of the chair and rail in plan and profile, as the minute accuracy of the above description will answer a much better purpose. The peculiarities of this system of construction are, the disuse of longitudinal timbers of any kind, the mode of fastening the rails in the chairs, and for allowing at the same time for changes in temperature.

The advantages attendant upon the longitudinal connection of the rails alone are, the saving of timber, at the time the road was built, a scarce article upon the Schuylkill; the broken stone or timber when partially decayed, with longitudinal bearers, will afford the means of passing water from a great distance so as to accumulate in such quantities as to prove dangerous

to the soundness of the road. Moreover, one more perishable article is stricken from the component parts of the road. The mode of fastening the rails from personal inspection, we nave satisfied ourselves to be excellent—the allowance for temperature being perfect, while no displacement of the rail can possibly take place. After all that can be urged in favor of the form of this rail, the best evidence of its merit is the fact that it answers the purpose for which it was intended. There are other forms which doubtless would prove equally serviceable—but this has been tried and already found excellent.

It is the duty of all who are familiar with the *superiority* or *inferiority* of any form of structure to make known their remarks upon it for the benefit of others.

By a singular mistake, our notice of Mr. Nott's advertisement was not inserted in the last number of the Journal. It will be seen that he aims mainly at private business, a source, in our opinion, sadly underrated, and as his experience and standing are unquestionable, we are happy to find him aiding the cause of the profession in the most efficient manner possible; that is, extending its usefulness by enlarging its field of operations.

IRON CANAL BOATS.

It was more than four years ago, and prior to any heavy expenditure on the enlargement of the Erie canal, that our correspondent, J. E. B., proposed the employment of iron boats on the canal. He urged on our canal board, as well as our forwarders, to build one, and to test their capacity. He argued, very naturally, that the same results would be found here, as had been experienced in England.

It is gratifying to find by the following extracts from the Miners' Journal, and from a late number of the Albany Argus, (making remarks on the "navigation of the Erie canal,") that this subject is at last claiming the consideration it merits. From inquiries made in this city, we have no doubt but iron boats, that will out last three wooden boats, can be constructed for $1600. Some of our best lake boats cost nearly this sum. The wooden boat is more subject to leake, and cause damage, arising from stones and obstructions that fall into the canals, than the iron boat. The latter are made perfectly water tight.

Iron Canal Boat.—The Miners', Pa., Journal contains a statement of the size, weight, cost, etc., of the new iron canal boat recently built at Pottsville. The light weight of the boat is 15 tons 12 cwt.; the weight of the boat and cargo was 85 tons 2 cwt., leaving a cargo of 69½ tons of coal. The boat draws 4 feet ½ inch midships, and 4 feet 1 inch at the stern—say 4 feet 1 inch draught of water. The cost of the boat is stated at about $2200. In future, iron boats can be constructed for about $1800.

From present indications there is also every probability that for the first time, next season, *iron canal boats* will be extensively introduced on the Erie canal, and as they can as easily carry 85 tons of freight as wooden ones can 70 tons, this also must have no inconsiderable influence in increasing the present *capacity* of the canal.—*Albany Argus.*

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